SOME MENTAL CHANGES

IN THE

GROWTH OF CHILDREN

AND THEIR

SIGNIFICANCE FOR EDUCATION

A

THESIS

submitted to

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by

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INTRODUCTION

THE AIM AND SCOPE OF THE PRESENT INVESTIGATION.

The present-day curricula in our schools appear to be the outcome of experience, - experience on the part of generations of teachers as to the particular subjects, and level of subject, which children at any given age have been found capable of tackling. Modifications are made with changing ideas or ideals, but in the main the curriculum is limited by the scholastic ability of the average child.

If, however, education is to become an undertaking designed to make possible the proper development of children, and not merely a technique by which to prepare them for future examinations, the standard to be expected of the average child must not be based upon an examination criterion. For the age at which a child can be induced to absorb and reproduce scholastic material is by no means necessarily the age at which this same material is fruitful or even healthy for his development. Even the class-room criterion - the opinion of the teacher as to what the average child can do - is not a psychological one. It is based on scholastic results; and the question as to whether the production of these results has been beneficial or otherwise to the child, remains unanswered. Usually it is not even asked.

Some criterion of a psychological kind is therefore essential. An enquiry, however, into the ability of children of different ages to tackle the different school subjects, is one much too wide for the present undertaking; but the problem, as the writer sees it, can fruitfully be approached from another and fortunately narrower angle; and this is the problem of the method of investigation itself. For unless the approach to the child in making an investigation, or to the data yielded by one, be without theoretical presupposition, and the investigation itself be calculated to bring all the relevant factors to light, it is clear that the psychological conclusions arising from this will tend to be distorted, with resulting repercussions upon educational practice.

An attempt, therefore, will first be made to arrive at a valid method of investigation; and thereafter some concrete psychological results of this method will be given, which will be focussed back upon some of the educational practices at present in use with a view to showing how far these can be justified, and to illustrate at the same time the illuminating power of the method used.

Curricula vary from school to school and district to district; but a general idea of a certain minimum curriculum can be obtained from that recommended for Education Authority schools, and the following is an outline of that recommended for Primary Schools by Edinburgh Corporation Education Committee. We shall consider only the more strictly scholastic subjects, and the ages at which these are begun. These are:

<u>Age 5</u>: Reading, Writing, Arithmetic, Nature-Study.
<u>Age 7</u>: History, Geography.
<u>Age 9</u>: Grammar.

The Arithmetic during the first year involves appreciation and understanding of numbers up to 10 with the use of concrete material, addition and subtraction up to that number, counting as far as 30, and knowledge of value of coins up to 6d.

Nature-study for the first year involves knowledge of the names of birds and other animals, flowers, etc., and observation of the daily weather.

History at age 7 is confined mainly to stories connected with historical buildings in the neighbourhood. At age 8 there are stories about Egypt and the Pyramids, Hannibal, Julius Caesar, Agricola, the Goths, Huns and Vandals, Alfred, and so on. At age 9, although still in story form, something more in the nature of a period is dealt with, this comprising chiefly Scottish history up to 1603.

Geography at age 7 begins with knowledge of north and south poles, equator, continents and oceans; knowledge of the origin of certain common articles; stories of children in other lands; and the learning of certain physical features - island, peninsula, cape, gulf, etc. - by means of a sand-tray or other medium. At 8 the child passes to a knowledge of certain Scottish rivers, mountains, towns, etc., together with certain facts connected with each town, as well as of certain industries such as Clyde shipbuilding, Dunfermline linen, Kirkcaldy linoleums, a knowledge of railways, etc.. At age 9 he passes to the geography of England and Wales, the Irish Free State, and Northern Ireland, with their towns, districts, products and industries.

Grammar, at age 9, begins with simple sentence-building from subjects and predicates, word-building, and knowledge of some parts of speech. Actual analysis of the sentence does not begin until 10.

The upper limits of this curriculum (age 11) are as follows:

<u>Arithmetic</u>: Vulgar and Decimal Fractions; Simple Proportion; Bills of Parcels.

<u>Nature-Study</u>: Life-histories of plants and animals; knowledge of certain minerals; movements of earth and moon in relation to the sun; seasons, tides, etc..

<u>History</u>: Period 1714-1815, treated as before.

<u>Geography</u>: British Empire.

<u>Grammar</u>: Sentence analysis; Parsing.

The above, of course, is a moderate standard of achievement, and there are schools in which more is expected. In one Edinburgh school visited by the writer, for example, grammar is begun as early as age 7. Again, Algebra is not normally begun until after the Primary stage, at 12; but the writer has before him a well-known elementary arithmetic book into the early pages of which simple algebraical exercises are introduced along with arithmetical examples in addition, subtraction, etc.. Here it is apparently assumed that a child at this stage can handle letters as readily as pure numbers, and the fact that the two processes are on different levels of abstraction, is ignored.

This points to one of the problems with which we shall have to deal. Is it a matter of indifference to the child on what level he is asked to think, provided that the mental operations are equally simple in degree? The educated adult can move freely on all levels; and A + B is as simple an expression to him as 1 + 2, and this, in turn, as 1 apple + 2 apples. Is the child-mind structurally the same as that of an adult, differing only in regard to the complexity of the problems which it can tackle? or is it different also in its nature? In other words, is the child a little adult, or is he not?

This question is fundamental for a school curriculum. For if the answer is in the affirmative, there is hardly any limit to the age at which a subject may be introduced, provided that it is kept sufficiently simple. If the answer is negative, it is of great importance for the well-being of the child as to whether a subject is given to him before or after a given stage in his mental development.

We are thus brought to the threshold of our first problem - the method of investigating the child's mental structure.

PART I.

THE INDIRECT APPROACH.

Broadly speaking, there are possible to psychology only two ways of approach to a study of the structure of the child's mind. The one is the direct method - the method of the mental tests - in which the child responds directly to a request for some mental or manual operation. The other is the indirect method, that of observing the child's natural behaviour toward his environment - physical and social - without the obtrusion of the investigator. The only other way of approach - introspection - is obviously not practicable with young children.

Jean Piaget, in his "Language and Thought of the Child" (1) and "Judgment and Reasoning in the Child" (2) uses both methods. Mrs. Susan Isaacs, on the other hand, in her "Intellectual Growth in Young Children" (3) gives us a long and detailed example purely of the second method of approach.

As a means of investigating the indirect method, we shall deal with it in the concrete as it is exemplified by Mrs. Isaacs' experiment; and in so doing we shall be able to examine not only the method itself, but also how far Mrs. Isaacs has adhered to it.

Mrs. Isaacs' experiment is at one and the same time an "education by environment" of the children concerned and a study of their behaviour in the course of that education. But the question of education by means of environment, or of a psychological study based upon it, raises at once the important problem as to the exact nature of the surroundings we are to select for the child. For if education is an affair in which the adult takes any part at all, and is not one merely of letting the children loose upon the world, to develop unguided like animals, it is plain that everything depends upon the environment which we choose for them; and the question arises: How is the adult to discover what ought to be brought to the child, and in what manner?

Mrs. Isaacs answers the question by surrounding the children in her school with the most varied environment possible, in order "to open the facts of the external world to him (the child) in such a way that he can seize and understand them." (p. 20) The child is not to be turned loose upon the real world, but a kind of filtered edition of it is to be brought to him. "The school is, on my view, simply a point of vantage for the child in his efforts to understand the real world, and to adapt himself to it. It should be a place of shelter for him; but not in the sense that it shuts the larger world away from him. Its task is to bring the world to him in ways and at a pace fixed by his needs and interests." (p. 21) Mrs. Isaacs does not explain how these "needs" are to be discovered, however; and we are left, apparently, to assume that they are identical with the child's "interests". School, teacher, and teaching, she adds, "are simply a clarifying medium, through which the facts of human life and the physical world are brought within the measure of the child's mind at successive stages of growth and understanding."

Thus, according to the child's manifested interests, the outer world is to be brought to him in a suitably simple form, so that he can grasp it intellectually and learn to adapt himself to it. In other words, Mrs. Isaacs' answer to the question would appear to be: Surround the child with a sufficiently varied environment, let him move freely in it, and his interests will be your guide as to his further requirements.

This method of investigation is chosen by Mrs. Issacs in contra-distinction to that of Piaget, whom she criticises on the ground that the environment in which his children were placed was too restricted, and that his "conversational" method does not elicit questions which the child would naturally ask when confronted with an environment of objects. "Sustained conversations between one child and one adult in one place do not provide the circumstances which would provoke questions demanding causal explanation, or inquiries about inanimate objects." (p.83)

While the possible importance of this objection is not to be denied, attention must be drawn to the exactly opposite error into which Mrs. Isaacs herself may fall. While Piaget's conversational method - and in general the more restricted environment in which his children found themselves - may not elicit all the interests which are present in the child's mind, Mrs. Isaacs' "environmental" method may easily yield us apparent "interests" which are not naturally present in the child at all.

These apparent interests may (a) arise through artificial stimulation, or (b) be the outcome of a mere misinterpretation of the behaviour of the children. As an example of the first, it might be asked: Are children of 3, 4, and 5 normally interested in the interior of animals?

In the data which Mrs. Isaacs has given us, under the heading "Interest in Animals" Section 1, and which covers three years of her educational experiment, we find the following: During the first 21 months, from 1.10.24 to 14.6.26, no single case is reported of a child wishing to investigate the inside of an animal, alive or dead. Any dead animal found by the children was invariably buried. Then, on 14.6.26, a pet mouse is found killed. "The children looked at it, and spoke of its teeth, tail, and fur." Then Mrs. Isaacs says: "Should we look inside it?" The children agree "eagerly", although the four little children concerned, age 3:9, 5:1, 5:9, and 6:10, shudder as the knife cuts the skin.

On 17.6.26, again at Mrs. Isaacs' suggestion, they dissect three crabs. On 18.6.26 a dead toad is found, and "Mrs. I. asked the older children if they would like to look inside it later, and they agreed." On 21.6.26 Priscilla, age 6:10, notices that the toad has been opened and pinned out, and expresses a desire to dissect it with Mrs. Isaacs; and on the same day she wants to "look inside" a cockchafer which appeared to be dead. <u>This is the first recorded instance of any of the children expressing such a wish on his or her own initiative</u>. Priscilla, however, had attended the school since the Spring of 1925. (It is true that on 3.6.26 Dan, (5:0), after examining the skeleton and anatomical diagrams, expresses a wish to see a man walking about with his skin off, so that he could "watch what happened and see the blood". But this may be taken as directly suggested by the bones and diagrams which he has been examining).

The next dissection, on 20.7.26, is again at Mrs. Isaacs' suggestion. She had chloroformed some pet mice, and three of the children dissected one each. "Priscilla again had some qualms at the beginning, and wanted to be assured that they were 'not hurting them'. She also said: "You wouldn't do this to us, would you?" ... "all three showed a little excitement about the cutting, but it soon passed ..."

On 22.7.26 three children dissected snails with Mrs. Isaacs.

At the beginning of the new session, on 31.10.26, Dan (5:4) telephones Mrs. Isaacs (it being Sunday) and tells her that he and the others want to cut up a pet rabbit which has been found dead that morning. Mrs.

Isaacs agrees, and the dissection duly takes place after tea. The children are all agog to begin, but two new-comers, age 10:5 and 5:9, are"moved emotionally" by the experience and express some "disgust and excitement, whereas Dan showed only a steady intellectual interest." Dan, however, said once or twice: "You wouldn't do that if it was alive, would you? Poor Pamela, (the rabbit), you are sure it doesn't hurt her?"

On 9.11.26 Dan and Conrad (5:5 and 5:10) write to the Zoo asking for dead animals to cut up.

On 15.11.26 Dan expresses a desire to examine the rabbit further, and at Mrs. Isaacs' suggestion they look inside the skull.

On 22.11.26 one of the teachers brings to school a mouse which has died of a tumour. "The children were very eager to cut it up and see what was inside the swelling." Seven or eight children sit round and watch Mrs. Isaacs open it up.

The period during which the children, of their own accord, express a desire to dissect animals, has covered exactly five months; and now a reaction appears to set in. On 24.1.27 a baby rabbit is found dead. Jane (10:8) suggests cutting it up, but later the children announce their decision to bury it instead. "It is so pretty, we don't want to cut it up, we want to keep it", Priscilla (7:4) explains.

On 27.1.27 a mouse is found dead. "The children were grieved, and decided, as they had with the young rabbit, that they would bury it, and not cut it up."

On 1.2.27 a pet mouse which had been accidentally killed was brought to Mrs. Isaacs by the children. "They said they were not going to cut it up, but to bury it - although there was more hesitation about this than on the last occasion."

During the morning the cat brought in two dead sparrows. "Some of the children wanted to cut them up, although Dan said 'Let's bury them!' The opinion in favour of cutting up prevailed, and Mrs. I. did so."

Nothing of a similar kind is reported until 23.5.27, when two of the young rabbits are found dead. The children were "very troubled about it, but no one suggested "looking inside' the dead animals."

So we have the following facts before us: For the first 21 months of the school's existence, i.e. for nearly 6 school terms, no suggestion was made by the children that they should 'look inside' any animal. Then Mrs. Isaacs makes the suggestion on three occasions within four days, and carries out the proposal on each occasion. Three days later, Priscilla (6:10) expresses the first spontaneous desire to dissect an animal.

The next dissection recorded, a month later, is again at Mrs. Isaacs' suggestion; and two days later another dissection takes place, presumably again at her suggestion, although it is not stated. Then the session ends.

At the end of the following October a definite request comes from Dan and one or two other children, and 9 days later a request for dead animals is sent by them to the Zoo. On 22.11.26 the last unanimous desire for dissection is expressed by the children. Then the reaction sets in. On 24.1.27, 27.1.27, and 1.2.27, burial is chosen by the children in place of dissection. On the last date there is also a non-unanimous return to dissection, but on 23.5.27, when an occasion once more arises, the matter is not suggested by anyone.

There is no question here of throwing doubt upon Mrs. Isaacs' contention that young children are naturally more interested in animals than in plants. It is a readily observable tendency. But to be interested in animals and their ways is one thing; to be interested in their anatomy is quite another. The former need not be a scientific interest; the latter is necessarily so - or else something morbid.

From this examination of the records with which Mrs. Isaacs herself has furnished us, we can only conclude that the latter interest was not normally present in her children, that it had to be deliberately induced, at the end of the sixth term, by the repeated efforts of an adult, and that the interest so induced in the children lasted, apparently, only for one term - from the end of the sixth to the end of the seventh - with the exception of one non-unanimous occasion early in the eighth term.

The fact that the children responded "eagerly" to the first suggestion is not a point on which an argument can be based. The curiosity of a child can be awakened toward any concrete object in the interior of which, it is suggested, there may be something to be discovered. The question of psychological importance - from the point of view of the environmental method - is not what curiosities can be incited in the child, but what curiosities arise in his mind of their own accord. There is no evidence in these records that a desire to look inside animals arose of its own accord, and there is evidence to show that, in spite of opportunity to the contrary, the interest so incited was not maintained.

This section of the records closes with an incident which is not without its humorous side. Anatomical interest seems definitely on the wane, and rabbits, mice, and sparrows appear to have lost their appeal. But Mrs. Isaacs seems determinded that the study shall go on, and she arrives at school one morning carrying a whole calf's head. It is a magnificent coup; the children's curiosity is caught once more; and the curtain rings down upon the merry scene of Mrs. Isaacs and Jane bisecting the head with a hack-saw.

That these children did, within the limits indicated, evince an interest in the interior of animals and of their own bodies in consequence, is not to be denied. So long as we keep to the concrete, there is no reason whatever why we should not be able to stimulate in young children an interest in anything which immediately concerns themselves, or in which they themselves can take an active part. But the question as to the period of development at which this interest should naturally awaken, and at which it would be most valuable to the child, still remains to be answered.

Mrs. Isaacs maintains that the experience of 'looking inside' dead animals caused these children to be more kind to live ones. Apart from the difficulty of distinguishing this as a possible cause, from others incidental to the children's activities - such as the daily care of the pets themselves - there is a much bigger issue to be considered. The question is, at what age is a child's mind ready to be orientated toward the environment in that particular relationship which we call "scientific"? For this comes even prior to the question as to the age at which anatomy is valuable to the child.

From the earliest age at which children can observe and recognise objects, we may speak of a <u>knowledge</u> of the environment. This involves the power of ideation in some form. The particular attitude of any given human being to his environment will depend therefore upon how he uses that knowledge, i.e. how he utilises his ideas, (using the term "idea" at the moment in the broad sense, to include mental imagery).

Observation of children and adults shows that three ways of using ideas appear to occur. The first may be called "Volitional", observed chiefly in young children when they "act out" in bodily movement the events which they see, or have seen, around them. It is the imitative stage - a desire to identify themselves with the environment to the extent of literal bodily movement corresponding to the movements of the objects seen. The second may be called "Imaginative", again most common in children, when the impression made by the observation of one object is projected on to another object, thereby transforming the latter in the eyes of the subject. The very young child tends toward the Volitional attitude, and when playing at "railway trains" will be the train or engine, making movements with arms and legs like those of the piston-rods or other parts of the machinery, and emitting appropriate noises like that of steam. But the slightly older child will tend to seize upon some external objects - such as articles of furniture - arrange them in a suitable way, and picture these as the train by projecting his imagery on to them.

The third attitude to the environment - the Objective attitude - is qualitatively different from both of these. It is the reverse of imitation which is identification of the self with the object. It seeks, on the contrary, to set the object over against the subject as something to be intellectually understood. Hence the resultant idea is not used for re-projection on to the environment, but is itself retained as an object of further contemplation.

In other words, the ego of the individual at this third stage stands in a quite objective relation to the idea, - confronts it. At the second stage the idea is not confronted as such, but is <u>used</u> for subjective ends, being confronted only indirectly in the projected situation. At the first, or imitative stage the idea is not confronted in any sense. The child is totally immersed in the idea. Not only does the ego of the child live in the idea, but his bodily movements appear to be controlled directly by the idea itself. The movements are literal; and this fact is to be distinguished from the play-situation of the older child, the movements in which are directed according to his phantasy. For even when the child plays the part of "engine-driver" in his own "projected" train, his movements are no mere slavish imitation of those of an observed engine-driver, but form part of the total dramatic situation in which he is an actor, and which is his own creation. He <u>acts</u> the part, and does not merely imitate. In other words, he lives in the idea, but he moves freely in it - that is, the bodily movement is not under the immediate control of the idea but is mediated by the ego of the child operating in terms of phantasy.

Thus we can distinguish these two situations by saying that, in imitation, not only does the ego of the child live in the idea, but that the bodily movements are controlled directly by the idea; whereas, at the imaginative stage, the ego can either live in an idea or project it, but that the bodily movements are free and directed by the child's own phantasy.

The exact significance, therefore, of a child's interest in an object or event is discoverable only when one observes how he treats the ideas he has so gained, - that is, whether he imitates the impression, acts or projects the idea, or objectively confronts it.

It is plain that the first two types of relation to the environment cannot be a basis for scientific thinking. Only the third could form such a basis. But scientific thinking is more than a mere ability to confront an idea objectively, - to be able, for example, to describe objectively some object previously observed. One must add to this the ability to think relationally - to see concrete ideas linked together into comprehensible wholes, and to grasp the relationship between these wholes. When this ability first makes its appearance in the child, we may begin to speak of the germs of the scientific outlook in him, but clearly not before that time.

The question now arises: How far should we expect the presence of either of the first two types of relation to ideas to preclude the possibility of a scientific attitude being taken on any occasion whatsoever? The child who can so far control his imagery as to be able to project it, can reasonable be expected to confront it, when required, and to treat it realistically. But how far can we expect this of a child in whom the impressions of the outer world seem to act directly on his motor system, as at the imitative stage, since the ego at this stage does not appear to exercise any mediating control? While the child who takes pleasure in living in phantasy and in projecting his imagination upon the environment is unlikely to be one who is prepared to consider that same environment in terms of classification and of abstract relations. For classification involves abstraction from the environment, which is the antithesis of projection on to it.

Only a reference to concrete data and analysis, of course, can settle such questions definitely; but these tentative considerations should be a warning lest we tend to read into a child's behaviour factors which perhaps cannot possibly be there. Yet it is just characteristic of the "little adult" attitude toward the child, that it makes this assumption. It assumes that phantasy and other characteristics of the child mind can exist side by side with a scientific orientation to the environment. Thus Mrs. Isaacs, viewing the children from this "little adult" standpoint, appears to see no reason why such tendencies and scientific interest should not co-exist in the child as in the adult.

But the adult uses his phantasy in quite a different way. Adult phantasy is not the phantasy of the child. The adult does not identify himself with his imagery, nor does he project it on to the environment. He stands outside his own phantasy and is not subjectively tied to it, as is the child. For this reason, phantasy and the scientific attitude can co-exist in the adult mind without the one interfering with the other.

When, for example, the adult studies his environment as a stimulus to his imagination for the purposes of some creative work - as novelist, dramatist, or artist - he does not re-project his imagery upon the real environment, but creates for the purpose a quite separate realm, namely, the novel, the theatre, or his canvas. He thus does not intermingle the one realm with the other, as does the child; and for this reason the two realms can co-exist in his mind in the form of two distinct attitudes to reality.

The difference between adult and child is not lessened by the fact that children ask a multitude of questions which appear to require a scientific or even a philosophic answer. For it does not follow that a scientific answer is the one that is sought for, or is suitable for the child. To assume that the answer must be a scientific one, is simply to assume the "little adult" theory at the outset. The alternative mode of answering is not fiction or falsehood, as many people appear to think. Truth can be expressed in other guises than that of the abstract or intellectual. It can be expressed pictorially, for example; and this may prove to be a much more fruitful way of answering the child than by giving him the kind of response which an adult mind finds satisfying.

For example, when a child asks: "Why don't trains stop and start off suddenly express?" (quoted from Nathan Isaacs' appendix to Mrs. Isaacs' book) he is not necessarily expecting an answer in terms of Dynamics. A perfectly adequate reply would be: "Well, neither can you, when you run!" This is not a causal, scientific answer; but it nevertheless conveys to the child through a "picture" - through a mental picture of himself as the train, when he himself tries to start or stop running at top speed - the dynamic <u>facts</u> of the situation. He then <u>feels</u> the need for gathering speed, or for slowing down - a much more satisfying and realistic explanation than any which theory could give him.

Or again, "Why does the water spread out flat (in the bath)? Why won't it keep up in the middle?" is a question put by a child of 4;5, quoted from the same source. At this age, when his attitude to the environment is still largely imitative or volitional, the child should readily understand an answer in volitional form; and one could reply: "Because it wants to run into all the corners." The child can then feel, by virtue of his own imitative tendency, the native tendency of all fluids.

Such an answer, with its voluntaristic flavour, may shock the physicist; but it in no way contradicts the physical theory, which depends ultimately upon gravitation - the tendency of solid bodies to attract one another. Is that a less voluntaristic expression?

It can thus be seen that such questions by young children can be answered in an imaginative or voluntaristic way, but one which in no way conflicts with scientific truth. It is not necessary to invent fairy-tales as an alternative. Later it will be shown, in the description of an actual teaching experiment carried out by the writer, how an abstract subject can be successfully taught by making use of a similar approach.

The putting of a question does not imply the ability to understand an answer. That is true even of adults. And it does not follow, when a child uses the word "Why?" or "How?" - even although the question be couched in causal terms - that he is capable of understanding the cause of the event which puzzles him, or even that he is interested in that type of explanation. It is not so much the question which gives us an indication of the child's stage of mental development, as the nature of the answer which he is capable of receiving.

Thus, neither the deeply philosophical questions of young children, nor their interest in objects of the environment, has per se much significance. One must first ascertain the nature of the answers which the child can receive, in the one case, and his general attitude toward the environment, in the other. These two problems are mutually dependent, since the child's power of comprehension at any stage will be a reflection of his attitude to the environment, and his attitude to the environment a function of his mental structure, or power of comprehension. Before discussing the manner in which this problem can best be approached, the position adopted by Mrs. Isaacs will be more fully considered.

This position can be seen from the following quotations (pp. 17,18);

"On the basis of previous direct observations of the behaviour of young children ... it was clear to me that children as intelligent as those in this group have a very direct and active interest in everything that goes on in the general world around them ...

Active pleasure in looking at these things, and eager curiosity about them, is one of the most striking features of the minds of intelligent children of two years and more. It has quite as large a place in their spontaneous behaviour as their delight in stories and "make-believe", in song and dance, and in all forms of "self-expression". And yet it has been very largely shut out of the tradition of schools for young children, even of progressive schools..

It is quite true, and a most significant truth, that the child's world is essentially a dramatic world. Undoubtedly, his direct interest in things going on around him in the home and the street has its roots deep in an intensely personal life. The records in this volume show how often and how readily the most active interest in these things slips over into the dramatic play of father, mother and child; but they also help to show that their deeper sources do not prevent these interests from leading on to real experience, and from crystallising out into forms of sustained inquiry, and delight in the actual process of discovery, which are at least anticipations of the genuine scientific spirit."

And on pp. 21-23, part of which has already been quoted and is restated here for the sake of coherence:

"The school is, on my view, simply a point of vantage for the child in his efforts to understand the real world, and to adapt himself to it. It should be a place of shelter for him; but not in the sense that it shuts the larger world away from him. Its task is to bring the world to him, in ways and at a pace fixed by his needs and interests. The school, the teacher, and the teaching alike are simply a clarifying medium, through which the facts of human life and the physical world are brought within the measure of the child's mind at successive stages of growth and understanding.

And it is the twentieth century world in which most children and certainly those in this group, are interested - the world of motor-cars, engines, aeroplanes, gramophones, and the wireless. These tools of use and pleasure surround them in the street and in the home, in picture-books and illustrated papers, and in the talk of grown-ups and older children. They have a quite direct appeal to the imagination and interest even of the younger children, who love to watch trains and trams, to be "the fastest train in the world", as they run round the garden, to draw or model an engine or a motor, a "wireless" or a system of roads and water-pipes. They hold attention and stir efforts of understanding quite as powerfully as dogs and horses, as things seen on a country walk or a visit to a farm, as stories of ancient heroes or the people of far lands. They are a part of these children's immediate and concrete world, which it is the business of the school to illuminate and simplify for their understanding.

Not only so: it is at the point of these concrete interests that the intelligent young child touches a characteristic element in the spirit of the modern world. When his mind moves out to these things and events, first by way of dramatic value, and then by way of understanding the "how" and the "how much", he shows himself ready to enter into the scientific way of life. He makes it clear that pleasure in the active exploration of the world, and readiness to be guided by facts, already have at least an embryonic meaning for him.

As theorists, therefore, we were carried far into the remoter provinces of the philospphy of education, by looking at these direct and concrete interests of intelligent young children. And one of our problems inevitably became that of providing the means and devising the methods by which the children could sustain and develop these interests, as a part of their living delight in experience as a whole. Clearly there is no room for "science" or any "teaching" of science in a school for little children; but there is ample occasion for meeting the actual movements of the children's minds towards "finding out" about the world around them.

Our theoretical aims in this could be stated from either of the two opposite ends of the problem. (1) To find suitable ways of giving satisfaction to this among all the other educative impulses of children; and (2) To discover the beginnings of the scientific spirit and scientific method in the thought of young children, with a view to making sure of their amplest development."

In the light of our fore-going analysis, we may agree entirely with the facts stated at the beginning of the above quotation, namely that children have an active interest in everything that goes on in the world around them. But, as we have just seen, such "active pleasure in looking at these things" must not be assumed without proof, to be due to a natural scientific interest; and it cannot be claimed that "dramatic interests" lead on, in any psychological sense, to experiences "crystallising out into forms of sustained inquiry, and delight in the actual process of discovery," if by these we mean interests of an objective scientific kind. This is the other source of error capable of arising through the method employed by Mrs. Isaacs - the possible error of misinterpretation of the children's behaviour.

"Experimentation" and "interest in discovery" are terms applicable to scientific activities, but not all experimentation and interest in discovery are scientific. Every human being has to discover the brute facts of his environment - to learn how things behave in varying situations and he has a natural impulse toward discovering this at a very early age. Each new discovery - unless it have painful consequences - brings pleasure to the discoverer because, apparently, of a fundamental impulse to make himself "at home" in the world. This impulse would appear to be a spring below which psychology cannot dig. It arises from the very centre of human life; and to ask why a child seeks to know his environment is as fruitless as to ask why one solid body tends to be drawn toward another.

This discovery of the natural environment and of human relationship to it - what will burn, and what will not; what solid objects can be easily modified, and what can not; what will float, and what will not, and the like, - have been common human knowledge for many thousands of years. Physical science, on the other hand, is of recent birth - a matter of four or five centuries. It is plain, then, that concrete knowledge of the environment, and physical science are not to be confused. Science began when men were no longer content to know merely what the environment contains or does, but asked what are the laws which govern it. We thus return to the point already made, that science is not a mere knowledge of the environment - however objective and factual - but a grouping of objects and events into related wholes, arrived at, in the long run, through abstract relational thinking. It is the desire to do this which constitutes the genuine scientific spirit; and while of course an objective factual knowledge of the environment is first necessary, an interest in this can no more be said to be an "anticipation" of the scientific spirit, than a child's interest in stones can be said to be an anticipation of an interest in architecture. It is the manner of the grouping together of the stones which constitutes architecture, not a knowledge of the stones themselves, or of their behaviour, however necessary that knowledge may be to the architect.

We have already seen how, in the records relating to interest in animals, the children's interest in dissection was the outcome of adult influence. If we now examine the section of the records entitled: "Increase of Knowledge: Problems and Experiment, Observation and Discovery" (p.125) we find the following:

On 27.1.26 a Bunsen burner was introduced into the schoolroom. From that date until the end of this section of the records, in October 1927, there took place some 42 instances of acts which, on the broadest possible basis, might be termed "experiments", initiated by the children themselves. Of these, no fewer than 23 were connected, directly or indirectly, with this Bunsen burner, and 6 were connected with other apparatus, namely, a U-tube (2), pulley-wheels, a balance, a drilling-machine, and a vice.

Thus we see, in the first place, that more than two-thirds of all the "experiments" recorded during this period (apart from the Biological records) were connected with scientific or mechanical apparatus. Now there are 20 pages in this section which extends from October 1924 to October 1927. The Bunsen burner, therefore, was introduced within two months of the middle point of the records in regard to time. Yet the records prior to its introduction occupy 4 pages, and after that point 16 pages, while the ratio of actual "experiments" before and after that date is 10 to 42.

In view of these figures it can hardly be denied that the activities of these children were largely orientated by means of this artificial environment. For it must be emphasised that an environment of scientific apparatus is an artificial one - a secondary environment produced by the adult in his desire to investigate the natural, or primary environment. The scientific impulse came before laboratories; and if a scientific attitude were naturally present in the young child, it should arise through his contact with the natural environment, and should not need laboratory or mechanical devices in order to stimulate it. In short, the presence of scientific apparatus should arise from a scientific interest, and not the scientific interest from the presence of the apparatus.

Mrs. Isaacs, however, assumes that the children's "immediate and concrete world" is something which "it is the business of the school to illuminate and simplify for their understanding", and that "when his (the child's) mind moves out to these things and events, first by way of dramatic value, and then by way of understanding the "how" and the "how much", he shows himself ready to enter into the scientific way of life." These assumptions on her part, made without pausing adequately to consider what other interpretations might be placed upon the children's behaviour, explain the presence of the apparatus.

In order to see how far this assumption was justified, let us now analyse the cases of "experimentation" which occur in this section.

Experiments may be of two kinds, - haphazard or purposive. The first can be characterised simply as play - a more or less idle fiddling with objects or apparatus, now trying this, now that, just to see if anything interesting or exciting will happen. The second can always be identified by the deliberate placing of an object or objects in varying situations, or placing various objects in the same situation, with a view to discovering how the objects will react. The essence of purposive experiment is thus the comparison of events with one another, these events having previously been brought by the experimenter into comparable relations. The outcome must be at least some elementary classification.

But this purposive type may be one of two kinds, according to the purpose, which may be to discover either (a) an empirical classification of facts, or (b) a law or principle governing that classification. Only the latter can be called <u>scientific</u> experiment.

Examining now the whole of this section (from October 1924 to October 1927) there are 52 instances of experimentation. Of these, only 10 can be said to be purposive; and if we look among these for evidence of an attempt to formulate a principle or law of the simplest kind, we find there is only one.

Those classifiable as purposive are as follows:

12.11.24	Melting of wax on hot pipe.
19.6.25	Seeing what will float.
do.	Seeing how paper will float.
8.7.25	Seeing if some objects will float.
9.7.25	Seeing how the window looks between one's fingers.
16.4.26	Burning wool and cotton.
21.6.26	Balancing wooden boards over edge of table.
16.11.26	Experiment with thermometer and boiling water.
25.2.27	Experiment with Jeyes' fluid in water.
26.4.27	Experiment with chalk on wheel of mouse cage.

Only two of these are in any way connected with the available scientific apparatus, namely, that on 16.4.26 and on 16.11.26, involving the Bunsen in both cases, with some additional apparatus in the second. Others, again, which at a casual glance look as if they were not merely purposive but actually scientific, - such as the experiments with the U-tube (22.6.26 and 25.1.27) - cannot be included in this list. The children's conclusions in each of these cases are as follows:

> "We found a U that is a bottle, and if you put water down into it, it goes up the other side of the U. The water weighs up and down when you've done it, like a scale."

and: "We've found out that if you keep your finger in one end of the tube, you can't pour water down into the other."

In each case we have nothing more than a simple empirical datum, neither connected nor compared with anything. These instances may be contrasted with the purposive action of the children in placing various objects upon the hot pipe (12.11.24) in order to see which would melt and which would not, thus comparing different objects in a given situation and making an elementary classification of them into melting and non-melting objects.

Of the above 10 instances, all are empirical in aim or result except one - the first of those on 19.6.25. It is recorded as follows:

6. 3. 25 Plasticine put under the piano.
4. 5. 25 Mixing white and yellow plasticine.
16. 6. 25 Putting ice in water.
27.11. 25 Trying to make ice.
do. Trying to melt snow.
27. 1. 26 Varying air supply to Bunsen.
29. 1.26 Melting glass.
1. 2. 26. do.
5. 3. 26 Unscrewing nuts of table legs.
17. 6. 26 Melting glass.
22. 6. 26 U-tube and water.
14. 7. 26 Playing with hose-pipe.
4.11. 26 Feeling heat of steam from kettle.
20. 1. 27 Discovering adjustments of drilling machine.
24. 1. 27 Melting glass.
25. 1. 27 U-tube and water.

The remaining instances of "experiment" can hardly be taken seriously, even as evidence of a pursuit of factual knowledge. We have to bear in mind that children are interested not merely in the factual aspect of their environment, but are attracted also - and perhaps at this early stage very largely so - by the feelings, emotions, and sensations which the environment arouses in them. For example, young children are especially interested in any object which changes or moves, or in anything in which their phantasy sees the eerie or mysterious, or simply in new sensations of colour, touch, smell, and the like.

There is definite excitement for the young child in the experience of a moving train, a galloping horse, or an aeroplane, apart altogether from knowledge of them as objects; there is a thrill for him in peering down a well, or into a dark cave; and there is endless pleasure for him in playing with fire or flame and in setting objects alight. In the last case there is the double attraction of the flame itself and the power which it gives to him who uses it, and the element of excitement or surprise at the changes in objects which it may bring about; and if, in the process, varying colours of flame are produced, the emotional excitement is further increased. But all these are subjective interests and have nothing to do with a desire for knowledge, even although knowledge may in some cases be acquired through them.

A child of 5 who rushes repeatedly to a neighbouring railway bridge to watch passing trains, evinces an emotional excitement which the mere factual or cognitive aspect of the event can hardly justify; children who peer down a well or into an open street drain, are attracted probably at least as much by feelings of mystery or emotional curiosity, as by an interest in water supply or civic sewage; and it is fairly certain that children who crowd round a street bonfire are not there because of a scientific interest in combustion. Similarly, if we put a Bunsen burner into the hands of a child of 4, we must ask ourselves how much of his consequent behaviour is mere play - a desire to see something happen because of the surprise and excitement of it - before we begin to speak of his cognitive interest in discovery.

Let us follow the behaviour of Phineas (4:0) with the Bunsen. The underlined portions of the following quotations should be noted.

"17.12.27. Phineas spent almost the whole morning with the burner. He gave it the most absorbed and concentrated attention, and showed much ingenuity and invention in thinking of fresh things to do with it, and <u>the greatest delight and excitement over the different happenings</u>. When the burner was first put on it would not light. On an earlier occasion some melted lead had fallen down the pipe and blocked it. In order to make it burn Miss C. unscrewed the pipe and cleaned out the hole with a pin. When it was burning normally Phineas presently asked Miss C. to take off the vertical tube again, and had it lit without this; then put the tube on again but lit the flame at the bottom. Then he managed to get a flame both at the top and at the bottom by placing spent matches through the air hole horizontally. Then he turned the gas out, and filled the vertical tube with burnt matches, and re-lit it. He found this gave a different kind of flame, and watched all the colours with great delight. Later on, when he had matches in the tube, he lit the burner at the bottom only, and this made the matches smoulder."

"21.2.27. Phineas asked for the burner again .... He again spent the morning with various experiments, sometimes lighting it at the top, sometimes at the bottom. Presently he wanted something else to burn, and put a stick in the flame; but Miss C. asked him to burn sticks on the bonfire, not in the schoolroom. He said, 'What else can we burn?'"

"Lena was eating an apple, and suggested cooking this. They put the apple, and a brown paper bag, in water in a saucepan, on a tripod over the Bunsen. Presently they added some raffia, and they put so much in that it hung over the sides .... With a little help it was pushed in and flame lit. They saw that the raffia stained the water."

"22.2.27. Phineas again asked for the burner, and held some crystals of coloured bath salts in the flame. 'It all goes white, doesn't it?' he said. Miss C. 'What makes it go white?' 'The flame.' He repeated several times in his characteristic way, 'It all goes white, doesn't it?'"

He later put a saucepan with raffia on the tripod.

"24.2.27. Phineas on arrival wanted to cook, and put some water into a small kettle and took it to the burner. The saucer containing some of the bath crystals which he had used a few days earlier was there, and he played the flame of the burner directly on to them. When they melted he said, 'Look, it's all juice - isn't it nice?' The burner was partly choked and he cleaned it out with a pin. He left the pin in the hole when he lit it, and the flame spread out fanwise. He was delighted with this, and later put two pins in. Only the points would go in, and the length of the pins standing up could be seen to get red hot, and to bend over. Then he turned out the flame, and asked Miss C. to fix in three pins, and again watched the result of heating them in the flame. Later he heated the raffia in the saucepan again, and held a teaspoonful of water in the flame, watching the bubbles of steam. When the spoon got too hot to hold he got another. Then he held the flame of the Bunsen near the water, and presently put it right in. When it went out he asked 'Why did it go out?' Miss C. 'Why?' Phineas: 'Because of the water.' When he was intending to relight the burner while holding it near the water, the gas ignited after it had passed through the water, several inches away. He was excited at this, and asked 'Is the water burning?' Miss C. asked, 'Does water burn?' 'No' he said, but asked the same question in a puzzled way several times. Miss C. asked 'What is burning?' He replied 'The air'. She said, 'Is it air coming from the pipe?' At this moment Conrad came up and said 'No, it's gas.' Later Phineas tried to reproduce the distant flame, "3.5.27. Today several of the children asked for the burner .... Phineas asked for a saucepan, and they put some water in it, with bath salts, soap flakes, and later orange juice and an apple .... Their interest today seemed to be much more in the pleasure of their own activities, stirring, pouring, etc., than in the results, the changes due to heat, etc.."

The above has been quoted in order to show the behaviour of one of these children - a child whose name is cited, in connection with experiments, at least three times more frequently than that of any other individual child, from the time of the introduction of the Bunsen burner until the end of the records. It cannot therefore be maintained that he does not adequately represent this "interest in discovery" which we are discussing. To simplify the investigation further, only those experiments made by this child in connection with the Bunsen have been quoted. We have thus a continuous record of a representative child engaged in experimentation of various kinds with the same instrument.

First he plays with the burner itself, doing all sorts of things with it and showing "the greatest delight and excitement over the different happenings". He then manages to light it at both top and bottom by means of inserted matches, giving a different kind of flame, and he watches "all the different colours with great delight". Then, on the next occasion, when looking for "something else to burn" he passes on to "cooking" an apple, brown paper, and raffia.

Next day he holds some coloured bath salts in the flame, with the remark "It all goes white, doesn't it?" and then water and raffia are "cooked"in a saucepan. A few days later he again wants to "cook", but his eye is caught by the bath salts left over from the previous occasion, and he plays the flame on these until they melt. "Look, it's all juice.

Isn't it nice?" Next a pin is left accidentally in the burner, which causes the flame to spread out fanwise. "He was delighted with this", and he tries two and then three pins; then he cooks some raffia, boils water in a teaspoon and watches the bubbles of steam. Later, by accident, the gas becomes ignited after passing through the water; he is surprised and puzzled, and apparently, in spite of his questions being "returned" to him by an adult, and the more practical help of a contemporary, he is unable to grasp the situation. Next day he discovers an old and wet match box, which he dries and burns, and is puzzled by the differently coloured flame emitted by the striking portion. Then he pushes a match through the hole of the burner and discovers that the burner makes a noise like an aeroplane. "It's _my_ aeroplane. Isn't it a funny noise?"

Some weeks later he melts some soda crystals, watching the "juice" bubble over and run down the side of the tube. He does this many times over. Then he puts heated objects into water to hear them "sizzle", and is more delighted the more noise they make; and the record ends, some six weeks later, with the cooking of bath salts, soap flakes, orange juice, and an apple.

Apart from the frequent resort to cooking, which can be described only as imitative play, we must note the reactions of this child to the various events, - his "delight and excitement over the different happenings", the delight with which he watches the different colours of flame, and the flame spreading out fanwise, and the bubbling of the juice over the edge of the burner - repeated many times; the excitement with which he hears the noise like an aeroplane emitted by the burner, and the delight afforded by the sizzle of the heated objects when put into water.

It is plain that his interests are in colour, sound, movement, and in bringing about such changes, all of which seems to give him aesthetic pleasure, or excitement. This is quite a different thing from being interested in the events themselves as objects of intellectual cognition. Mrs. Isaacs does not appear to make this distinction; and it is only when the children depart so far from the appearances of a scientific interest as to cook bath salts, soap flakes, orange juice, and an apple, that she is constrained to remark: "Their interest today seemed to be much more in the pleasure of their own activities, stirring, pouring, etc., than in the results, the changes due to heat, etc."

But an interest in change may be either an interest in seeing the change take place, or an interest in the results of the change. And an interest in seeing the change may be due to the mere pleasure of witnessing change for its own sake - a desire for sense-stimulus, - or an interest in the manner, sequence, rapidity, etc., of the process itself, - i.e. a cognitive interest. While an interest in the results of the change may be due to the excitement of new sensations of colour, sound, etc., or an intellectual interest in the new state of the object. Mrs. Isaacs seems always to attribute to the children the latter alternative of each of these possibilities.

When adults go to witness a firework display, their interest lies in the mere element of surprise and pleasure due to the sudden appearance of unexpected arrangements of colours and forms, and in the movement and change of these colours. We do not imagine that they have gone there on account of a scientific interest in the combustibles and in the chemical changes which they are undergoing. Why, then, should Mrs. Isaacs assume that children - who are even more susceptible to the pleasures of such sense-excitement - should be interested always in the intellectual aspect of their "experiments", instead of in the mere delight of a "spectacle"?

There can hardly be any doubt that the activities of Phineas, quoted above, and which occupy so large a portion of the records concerned, are due to a search for excitement of one kind or another; and, when this is found, it will be noted, the experiment is repeated again and again. But a search for excitement is just the contrary of a search for objective knowledge. The interest is not in the object for its own sake, or in knowledge for its own sake, but in the subjective effect which the discovery produces. To overlook the fact that a child indulges in this search for excitement in his environment, slumping all his "explorations" under the heading of intellectual interest, is to conceive of him not merely as a little adult, but as a little intellectual god.

The whole explanation would seem to be that Mrs. Isaacs, first of all assuming the "little adult" theory, confuses two forms of pleasure, - the naive and purely sentient pleasure of the child, afforded by a discovery because it is spectacular or unexpected, and the intellectual pleasure of the adult, afforded by the discovery of new truth. But unless we are prepared, in a psychological study, to begin by making such elementary distinctions, we can hardly hope to rise above the level of dilettantism.

The interests and activities of the other children appear to show as little cause for intellectualistic interpretation as those of Phineas. A few will now be quoted:

"7.10.26. Tommy (4;7) experimented with the way that a number of draughts would roll when they were stood on edge in a row, and started to roll by a push with a pencil."

We should note here again the factor of movement in the interest.

"21.10.25. The lights in the schoolroom are on pulleys, and Frank (6;0) today pointed out "that white thing above the light" (the china weight of the pulley) and asked, "What is that for?" Mrs. I. pulled the light down until it was within his reach, and he made it move up and down with great interest, calling the others to "come and see". The children then asked Mrs. I. to pull all the six lights down low, and they made "houses" under each of them. They all felt the bulbs, 'Feel how warm it is.'"

Here once again we have a moving object. Would Frank have continued his interest if the white object which first attracted him had been a fixture? Then, it is to be noted that as soon as all six lights are pulled down low, the children - instead of continuing to investigate the mechanism, as one expects they are going to do - immediately begin to play "houses" under each of them, and are attracted by the sensation of touching the warm bulbs. The record here could hardly show more plainly how evanescent was the children's interest in the pulleys. Nevertheless, such incidents prompted Mrs. Isaacs to procure a set of aluminium pulleys which could be fixed to the walls of the schoolroom or elsewhere, because "they were very interested in the mechanism, but the pulleys were far too high for the children to see them clearly." (p.36). It is always the same intellectualistic assumption, - no allowance being made for the pleasure of watching or controlling something which moves.

Then we find one or two instances of curiosity being aroused by "mysterious" noises proceeding from the water-pipes:

"12.1.25. There was much excited interest in the bubbling sounds made by the hot-water pipes this morning. The children kept running to listen to them, and wanted to climb up so as to see the cistern."

"8.12.25. It had been a severe frost for some days. During the morning, the children heard a noise in the lavatory cistern, due to its sudden filling on the thaw. They ran to the cloak-room and said, "It's the unfreezing of the water," and watched the tap in the basin beginning slowly to trickle. They talked at length about the frost, frozen water, frozen and burst pipes, the gas not working, and so on."

Unless there were other incidents relating to the water-supply which the records do not disclose, such "interests" seem hardly to necessitate the introduction of a glass U-tube on 22.6.26:

"The children having long been very interested in the problems of the water-supply, today Mrs. I. gave them a glass U-tube."

The two incidents above quoted, appear to be quite adequately explicable in terms of mere curiosity over something heard but not seen. In any case, when the glass U-tube did arrive, the records do not show that the children connected it in any way with the water-supply.

Finally, three further references to Phineas should be noted, in which he is engaged in other interests than that of the Bunsen burner:

"19.1.27. After lunch Jessica (4;3) began unscrewing the handle of the vice on the carpenter's bench. Phineas (3;11) took the second handle, and they took the vice right off twice and screwed it on again. After about two turns, Phineas went round to the other side of the bench to see how much further in or out the screw was. Every time, he called to Miss C., "Come and see how far it is now," and was not satisfied until she had looked. He did this perhaps forty times and said exactly the same phrase every time, and showed the same pleasure and triumph in his achievement."

Once again we have an interest in movement and change for its own sake, accompanied by a delight in the power to control that change. That the interest here is not cognitive is seen by the fact that the act was repeated about forty times, with the same pleasure each time.

"27.1.27. Miss C. was mixing some starch paste, and Phineas (3;11) said he wanted to do some. He watched Miss C. do hers, then asked for a pot the same size, and an equal amount of starch. He mixed it first with a little cold water, as Miss C. did, then asked her to pour in the boiling water; but finding the steam hot, he would also put in cold water. When the jar was full he was very disappointed that it had not turned blue as Miss C.'s had done. '<u>Why</u> didn't it turn blue?' Miss C. told him that it was probably because he had put in too much cold water, and asked whether he would like to heat it on the gas cooker. He said 'Yes' eagerly; but when it was put on the gas, he was so interested in the gas jets that he forgot about the paste. He asked perfunctorily, 'Has it turned blue?' but didn't really look at it. He asked Miss C. to light and turn out and re-light all the different jets several times over."

The first part of this record is a perfect example of imitation, and is just what one would expect of a normal child of that age. Note how he first watches Miss C., then demands the same size of pot and the same quantity of starch; then he adds water, first cold, then hot, just as she did, and is disappointed when the colour is not just the same as that of Miss C.'s starch. But the imitative attitude is just as remote from the scientific cognitive attitude as any human activity can possibly be. Finally we should note the ease with which the interest is lost and turned towards the lighting, turning out, and re-lighting of all the gas jets, - once more an interest in movement and change.

"4.2.27. When Phineas (3;11) had eaten his orange, he went to wash his plate, and asked for something else to wash. He was given a mug to wash, and spent twenty minutes slowly pushing the mop in and out of the mug, watching the water come up round it, and saying, 'Look at the bubbles'. The mop fitted fairly tightly, and he experimented with the suction as he pulled it, and noticed the way that the water came up round it as he pushed it in."

Again we have an interest in movement and change. Were this a cognitive interest, two minutes rather than twenty would have been adequate to disclose all the facts of the situation.

To sum up our examination of this section of the records, we have seen that, on analysis, no case is recorded of any child showing a genuine scientific approach to the environment in any experimental act - any approach which shows a quest for knowledge beyond the factual. Only in one case is any attempt made even at a generalisation of the results of the experiment.

Secondly, of all the instances classifiable as "experiments" only 10 out of 52 have any appearance of being purposive, 16 show an interest in single facts, and the remaining 50% can be adequately explained as the outcome of a delight in movement and change, in colour, and in new sensations generally, or as the result of the imitative impulse.

Thirdly, there is strong evidence that the activities of the children were artificially orientated in the direction of experimentation, by the introduction of scientific and other apparatus not normal to the environment of young children, to the extent that the number of experiments was more than trebled after the introduction of the first piece of apparatus. In the first sixteen months there were 10 experiments, and in the following twenty months 42 experiments, which is a ratio of 1 to 3.36: and of these 42 experiments 29 were connected with the apparatus. Only 2 of the latter, however, are classifiable as purposive. On the other hand, of those experimental acts connected with the normal environment, 10 took place during the first sixteen months and 13 during the succeeding twenty months, which is a ratio of 1 to 1.04.

Mrs. Isaacs maintains, however, that any apparatus of this kind was procured only as and when the children themselves gave indications of their need for it,

> "It was the behaviour of the children themselves, and their eager questions about cooking, about water and snow and ice and the garden bonfire, about the drains and the gas-pipes and hot-water

pipes and electric light, that led me gradually to give them material that would allow of these interests being followed out for their own sake." (p. 81)

But it is just in this sentence that Mrs. Isaacs begs the whole question. Enough has been said to show how unjustified is the assumption that this interest - when it has not a merely subjective source - is anything more than a desire to know the mere facts of the natural environment, - facts which, just because they belong to that environment, lose their full significance when transferred to a laboratory. (Of the best group of experiments, four-fifths are _not_ connected with the apparatus). If it be true that a child wants to know his environment, - how he should meet it, and how it will react to him, - it is surely of the first importance that he should meet the facts of that environment _in situ_, not in a laboratory, where, for the necessary purposes of science, events are abstracted from real life.

In introducing these artificial conditions Mrs. Isaacs tends to defeat the very object with which she set out, namely, "to open the facts of the external world (the real external world, that is, not the school "subjects") to him in such a way that he can seize and understand them." (p. 20). Yet she places a Bunsen burner in the hands of Phineas, whereby he spends innumerable hours (which might well have been spent in learning some of these facts of "the real external world") in learning simply how to play meaningless tricks with a Bunsen burner.

Of what conceivable educational value is it to a child of four to know what happens when you stuff matches into a Bunsen burner, or what to expect when you leave a pin inside? Is it important for him to know that gas will ignite after passing through water, or that bath salts will melt?

There is a mental confusion here in Mrs. Isaacs' educational theory. She does not observe that it is just in this laboratory atmosphere of isolation from the real world - the atmosphere of the student and the specialist - that we are in the midst of those conditions out of which school "subjects" arise. She is anxious that the children should learn directly from the real world, but she is also anxious "to discover the beginnings of the scientific spirit and scientific method in the thought of young children, with a view to making sure of their amplest development." (p. 23). Convinced, at the outset, that such a thing as the beginnings of "scientific method in the thought of young children" really exists, she proceeds to interpret in this light all their factual interests, together with as much again that is purely subjective in origin.

Further, this intellectualistic assumption regarding the young child cuts continually across another of her main purposes, which is to allow the children to come into personal touch with their environment unaffected by the mediation of an adult mind, (p. 40). For, in avoiding verbal mediation and knowledge given purely on adult authority, she forces upon them something else - compelling them to adopt, not adult authority, but an adult <u>attitude of mind</u>. To her, of course, this is not an interference with the liberty of the child's mode of mental growth, because of the "little adult" theory which she presupposes; and therefore she does not see that she may be obstructing the children's own view of the natural environment whenever she encourages them to regard the world through the medium of scientific apparatus, or to take an adult, rationalistic view of all their little discoveries.

This is especially in evidence when she or her co-workers insist on "returning" a child's questions to him, worrying him for "whats" and "whys", and thus, actually, forcing themselves upon him in a much more effective manner than any merely verbal mediation is likely to have done. For this is more than a mere giving of adult information to the child; it is an attempt to force the very structure of his mind into an adult mould.

Mrs. Isaacs ignores the important psychological fact that a child does like to ask questions of an adult, and that he looks up naturally to adult authority rather than to his own powers of observation and judgment. She does not pause to consider that there may be a reason for this, other than that of the child's own ignorance, nor does she ask, since the children apparently <u>could</u> reply correctly to questions thus "returned" to them, why this tendency was nevertheless there.

"The general methods of the school" Mrs. Isaacs states (p. 23) "aimed at encouraging the children's own active efforts in as many directions as possible." Scientific apparatus, however, and the abstracting attitude which goes with it, is the embodiment of the outlook of the adult mind upon the world. It is the medium through which the adult likes to study his environment. But if we are genuinely anxious that the child should contact his environment freely and in his own way - if we really wish to encourage him in his "own active efforts" - we contradict our own purposes if we introduce to him instruments which distract his attention from the natural world, and a mental attitude which forces him to contact his environment in <u>our</u> way. In effect, Mrs. Isaacs does not stick to the rules of her own game.

Of course, she would argue, the introduction of this apparatus was merely to serve the purpose of bringing the natural environment to the child in a nearer and clearer way. It was always a <u>simplification</u> of the outer environment which these instruments brought to him. But again this is to beg the question. For the adult wishes to have the environment thus simplified by his instruments for his own scientific purposes. He wishes to abstract from the complex world outside in order that he may discover the laws of that world. To introduce these instruments to the child is therefore to assume that he is more interested in the laws of his environment than in the concrete facts of that environment, in all their rich complexity. We tear the child away from his search after the concrete world as soon as we try to "simplify" it for him; and Mrs. Isaacs' own records show that the child is interested in the concrete, - not in laws and principles.

(An examination even of the section of the records entitled: "Reasoning: 'Whys', 'Becauses', and other Logical Interests" reveals none but concrete interests. The nearest approach to an interest in a "rule" or "principle" is the remark made by Frank (5;7) (p. 146) when, having dropped a pair of scissors from the gallery, he says: "They didn't break - they're metal.")

But Mrs. Isaacs has not taken the trouble to analyse her own records into these various levels of approach to the environment which we have tried to define here; and so all her geese are swans. Even the cry of delight of little Phineas (2;11) when, distracted from his tears by the sight of the lighted Bunsen, he exclaims: "I can see it burning. Oh, it's out now" (p.129) is listed under this section of "Increase of Knowledge: Problems and Experiment, Observation and Discovery". But there must be a distinguishing mark somewhere - a point at which we can say: "This pleasure is apparently due to the satisfaction of discovering new truth, - that is not." Otherwise, we shall find ourselves led to recording, as evidence of the scientific spirit, the gurgle of joy emitted by an infant at the sight of a brightly-coloured rattle.

By all means let us give young children the opportunity of "discovering" their environment, but do not let us call this a scientific pursuit - however embryonic - unless we can show that there is evidence of thinking in terms of related wholes. Until this can be shown, it is an absurdity to introduce young children to laboratory apparatus, anatomical diagrams, and the like; for such apparatus is an artificial construction - not part of the natural environment - and designed for the discovery not of the environment, but of the laws which govern it. And as for anatomy, this is a subject comprehensible only to an intelligence which can think in terms of organic relations. Mere factual knowledge of such matters is therefore not only futile but misleading.

But if we begin by making the assumption that a child's curiosities are evidence of a scientific spirit, and we thereupon present to him an environment which is itself "scientific" - in the shape of apparatus, anatomical diagrams, a human skeleton, and the like, - we need not be surprised if he begins to develop activities which superficially reflect that environment. He may make "experiments" with U-tubes, take the temperature of boiling water, or develop a curiosity as to the appearance of his own bodily interior; and the mere attitude of the adults around him is sufficient to lead him to adopt a self-conscious attitude towards all his own little discoveries, which otherwise he would not necessarily have taken up.

Children, one need hardly point out, very quickly take their cue from the surrounding adults. As Mrs. Isaacs herself remarks in a different connection (p.82) : "Little children are profoundly at the mercy of grown-ups and of the environment which grown-ups determine . . . "; and if these adults make a habit of regarding all the children's discoveries from a scientific angle, and of answering their questions - whenever possible - by reference to observation and experiment, or by returning the problem upon the questioner, - the children will very soon begin to adopt a similar attitude to the world of physical facts; and we may produce even the phenomenon of children of infant-school age pedantically requesting that their little discoveries be duly chronicled in a note-book. (p.136) All this, however, does not prove that the young child is an embryonic scientist. It merely goes to show that we can influence his mind if we try, - a fact surely too well known, however, to need such experimental proof.

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other desire than simply to enjoy his environment as a child, - that is, in the particular manner appropriate to his mental structure at the time. If he imitates a moving object, it need be no more than because he enjoys imitating, because the volitional element predominates in him. But imitation does not help towards understanding. It prevents it. For in understanding we must confront our idea of the object, in order to think about it; whereas in imitation, the idea, instead of being objectively confronted by the ego, is let loose upon the motor system where it works itself out in action. Thus, although at a later stage the child does begin to take an objective interest in engines and motor-cars, this cannot be said to be on account of the fact that at an earlier age he had imitated them. Imitation is fundamentally a motor activity with certain attendant pleasurable feelings, and has no necessary connection with an interest in engineering.

It is only when we regard the child superficially from the point of view of the adult, and do not enter into his point of view, that we are led into thinking of all his activities as leading toward an understanding of the world - toward <u>our</u> attitude to the world. This error can be avoided by analysing the psychological situation of the child when he imitates, projects his imagery, etc., as we have tried to do here. In regard to imitation, however, the present writer can vouch for the following:

When at the age of 7 or 8 he remembers playing "trains" with a friend of the same age. They were racing up and down on some grassy ground, each trying to be the "fastest express in the world" - exactly like Mrs. Isaacs' children. "I'm the 'Flying Scotsman'!" exclaimed one.

"Oh, but I'm the 'Flying Dutchman!" retorted the other. "That's much faster!"

The writer remembers his own thoughts and feelings very distinctly. There was not the slightest interest in the mechanical side of the matter - in any "how" or "why" or "how much". The pleasure involved was first one of free movement, and secondly a delight in identifying oneself with something big and powerful, in feeling this "power" in one's limbs, and in the pride of "being" that thing and of demonstrating that fact to others. The whole situation could be summed up as a love of movement, together with an enhanced self-feeling brought about by the identification of oneself with a powerful object.

In regard to questions about such objects, the writer can also quote the case of a boy about the same age who, watching trains pass through a country station, asked some adults present 'how many miles per hour that was'. He asked the question about each train after it had passed. Had Mrs. Isaacs been present, she might have seen evidence not only of an objective interest in mechanical objects, but in the relative speeds at which they were travelling.

As that boy, however, happens to have been the writer himself, he is able to vouch for the fact that the boy had no such interests. He was not at that time in the least interested in the mechanism (although a few years later he was very fond of playing with model steam engines and understood their working); nor was he interested in relative speeds. He was thrilled, however, to see this enormously powerful object hurtling past him at high speed, and, having been told that '60 miles an hour' was very fast (that was some 35 years ago), he hoped on each occasion that the train would be travelling at that speed and he there on the platform to see it. . . . Thus it is possible, by taking children's questions at their face-value, to read into their minds interests which are not there at all.

The same may be said of children who use their ideas of mechanical objects in their projected imagery. As has already been pointed out, the child is interested in these objects as material for his phantasy. It is not necessary to understand the mechanism for this purpose. After all, the child can use for the purpose of imitation or of phantasy only those objects which he sees around him; and, of these, naturally, he will tend to use those which are most commonly seen and which lend themselves best to imitation and to dramatic situations. It must be either something which moves, or something in which action can take place. Hence it is not in the least remarkable that modern children use ideas of mechanical objects in their play. In the modern world what else is there for them to use? That they are "interested" in these things is no indication whatever that the children bear within them the spirit of modern science. It is merely an indication of how far the spirit of modern science has influenced their environment.

It can thus be seen that, as far as a study of the child is concerned, the "environmental" method depends largely upon our interpretation of the observed activities of the child. We must be prepared to go behind the mere external behaviour and interpret it in terms of the psychological situation which the form of the behaviour indicates. We must pay attention to the form rather than to the matter, - to how children use the material of their interests, rather than to those interests themselves.

Thus, imitation indicates one mental situation, projected phantasy another; but we are no nearer to solving the problem as to how far one stage overlaps another, nor how far the higher intellectual processes are compatible with these psychological situations. We have seen so far only that higher intellectual processes need not be assumed to be present, and that no trace of the genuine scientific attitude is to be found in Mrs. Isaacs' records. But this is merely negative evidence; and the method is not exact enough to yield us a way of discovering what are the best ages at which to introduce certain school subjects to the child. For that is our ultimate goal.

As an educational medium, the "environmental" method is still less satisfactory. For it is based upon a quite untenable assumption. The guiding principle of this method might be said to be: "Let the child's interests be your guide as to what his mind needs." But, apart altogethe from the fact that a mere study of the <u>material</u> of his interests is no indication as to how these interests are to be presented, - it is also to assume that a child's interests, curiosities and desires are always wise and healthy, always coincident with his <u>needs</u>.

It will be noted that Mrs. Isaacs takes it for granted that, since mechanical objects surround the young child on every hand today, and since the child is attracted towards these things, this particular form of interest should be fostered. But it must be borne in mind first, that the child has little choice in the matter in a largely mechanised world, and secondly, that these objects, being an artificial production of man, and of recent origin, do not belong to the natural environment in which the human race has evolved. Surely a prior investigation into the mental structure of the young child is required, before we can pronounce as to the merits of this innovation in the environment as a factor in the education of the young child.

We are convinced that a child's physical impulses are not always healthy or wise, and that to turn him loose in a room full of all types of food would be disastrous. Yet Mrs. Isaacs would apparently have it that young children should be allowed to choose out of the environment any form of mental food which happens to attract them, that they should then be assisted in these pursuits, and that this is the main task of the educator.

The physical diet of a child is based upon a prior knowledge of what is nourishing, not merely upon the child's impulses; and it is surely not too much to expect that the mental nourishment of the child should be based upon a prior psychological knowledge. But psychological knowledge of this kind is just what we cannot obtain from the environmental method of study, since we have no means of distinguishing between the child's needs and his desires, and it is a fallacy to assume that they are coincident.

Further, the child is influenced by his environment - not only by artificial factors such as were introduced by Mrs. Isaacs, but by those very mechanical contrivances of the modern world which he can hardly avoid seeing and contacting. Therefore it is not a question merely of noting that the modern child is attracted by these things, and of trying to deepen that interest, but of pausing for a moment to consider whether it is fortunate or otherwise for him that he should be so influenced and have such interests, and whether it would not be better for him had he different material for imitation or for phantasy. This is an elementary educational question, - one which Mrs. Isaacs does not reach the point of asking.

If this activity of imitation, for example, is good for the child at all, would it not be better that he should imitate the free aesthetic movements of an animal rather than the rigid, restricted and mechanical movements of a steam engine? And if this be so, must we not rather consider how we may draw the child's attention as far as possible to objects which lend themselves to more aesthetic movement, and protect him as far as possible from those which do not?

Thus the brief consideration even of a simple question such as this, leads us in quite the opposite direction to that of the "environmental" method. Here the needs of the child would be in exact opposition to his desires, these desires having been conditioned by the modern environment, and not by the needs themselves.

The whole fallacy upon which this method of educational study is based, is just this identification of desires with needs. As soon as this distinction is taken into consideration it can at once be seen that this method can yield us nothing reliable.

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If we now turn to the method which Jean Piaget has developed in his "Language and Thought of the Child", we find that here the aim is to study the quality or structure of the child's mind, not by laying emphasis upon his impulses and interests, but by an analysis of his language and the quality of thought which it implies. We can thus discover what is the child's attitude toward his environment, as distinct from a mere knowledge of the things in it which attract him, since the latter has meaning only when the former has been already ascertained.

This method is partly direct, partly indirect. It may be classified as "environmental" in so far as it is a study of the spontaneous language of the child moving freely in his environment; while it partakes of the direct or mental test method in so far as the child is asked to perform certain tasks, - e.g. to explain to another child the working of an instrument previously shown and explained to him by an adult (p.83)

By such means Piaget arrives at certain conclusions regarding the quality of the child's mind at this or that chronological age, - a quality belonging to that age and differing from that of the adult mind. With these conclusions we shall not deal at present. Mrs. Isaacs, however, claims that the material given in her records "shows many disparate types of behaviour co-existing in the same children, and ranging freely between the phenomena characterised by Piaget to clear logical statement and reasonable action," and she therefore contends that the child is not dominated by one particular type of thinking at a given chronological age, but that the various types or levels are co-existent, given a suitable environment.

So far we have not dealt with the logical aspect of the records given by Mrs. Isaacs, a matter which will be considered later. Allowing, however, for the possible validity of the criticism made by her, that the environment in which Piaget's children were placed was too narrow, and that one less restricted would have evoked interests in causality and brought to expression other logical forms which Piaget did not find in his children's conversation, - we are led once more into the vicious circle of the "environmental" approach to the child. The environment affects the mental habits of the child, and from our enquiry into the mental habits of the child we are to gather what kind of environment is suitable for him. We travel in a circle, and can never arrive at any reliable criterion.

We must conclude, then, that while Piaget is right in wishing to examine the <u>form</u> of the child's thought rather than his interests, we still do not know how far these forms are the results of maturation or a mere product of his particular environment. We are thrust back, therefore, upon the investigation of the child's mental structure by means of some direct examination.

P A R T 2

THE DIRECT APPROACH

It is the aim of those who construct mental tests to include in the test various types of question, sufficient to yield examples of the child's ability in a number of different directions. Samples, as it were, are taken of a variety of his mental activities, and from the sum total of these his "intelligence" is ascertained and expressed in terms of a mental ratio.

But this result is an abstraction. It gives us no information about the structure of the child's mind, nor tells us anything about its present needs. To the genuine educator, who is concerned with the needs of the child and not with examination results, the intelligence quotient of a child should therefore be of comparatively little interest. It is of interest only to those who want to divide the "bright" from the "dull", so that they can "push on" the one and hold back the other.

These do not stop to ask whether it is good for the "bright" to be pushed on. Some act in this way because it is convenient for the existing school system to herd together children of one degree of brightness so that they can all be brought to the examination room at the same time, and because it involves far less thought on the part of the teacher to teach children who are all of the same level of cleverness. Others do so in the genuine belief that only in this way can the education of the dull be adequately attended to, and the bright given sufficient outlet for their mental energies. But this is a facile assumption.

If a child of eight is restless in class, a trouble to everyone, and "bored" with his schoolwork, and if it is subsequently found that he has a "mental age" of ten, it is very easy to say that the child's mental powers are not being fully occupied, and it is much the most convenient way out of the difficulty to push him up a class and give his mind so much more to do that he becomes docile.

There may be individual cases where this may be found the right thing to do, for the child's sake, after a very careful examination of his case; but it can by no means be assumed as a general rule. The question at issue is rather more complex. It depends upon in what respect the child is intellectually superior, - whether, for example, it is a question of greater mental agility, or whether it is a case of more mature mental structure. For these are not the same thing; and to give a child the work of a higher class merely on the strength of the former, would not be beneficial, but, in fact, almost certainly harmful. Further, there is the question as to whether the superior energies of such a child are really most fruitfully occupied in an increase of intellectual work, and whether it would not be better for his mental health to deflect them into some other channel, aesthetic or manual. Of all this the I.Q. tells us nothing.

There is one sense, however, in which mental test results can be psychologically valuable, and this lies in the raw data which they afford. When it is found that, at a certain chronological age, 60% or 70% of children can perform a certain mental task, while those a year or two younger can scarcely do it at all, we can begin to learn something of the manner in which the child mind develops, as well as something of its structure at any given age.

The term "mental structure" as it will be used in this thesis is now in need of some fuller definition. It has already been pointed out that the relation of the ego to its imagery and ideational system, and the relation of these to the motor system, may take several forms. In the young child, when he imitates, impressions of the outer world appear to act directly upon his motor system and to be not under the direction of the ego. In the older child, impressions in the form of imagery are used and projected by him to the extent that we can conclude that the ego had here some influence, although it tends to live very much in the ideas which it entertains.

The adult, on the other hand, does not live in his phantasy as the child does. He treats his phantasy objectively, and does not normally become an actor in it. He tends to turn to the life of imagination, or of philosophic and scientific enquiry, as his mood or interests lead him. He is not subjectively tied to any of his mental impressions as the young child is in imitation, or the older child in phantasy. This freedom of the ego to move among its thoughts, and, at will, to control them, - whether they be abstract or pictorial, theory or phantasy, - is what is specially characteristic of the developed adult. Mrs. Isaacs argues that this tendency to change from one mode of thinking to another is also largely characteristic of the child. The important differences between phantasy in the child and in the adult, however, have already been pointed out; and what remains of this question has still to be discussed.

By the term "mental structure" is meant just the characteristic relationship which exists, at any given age, between the ego, the ideational system, and the motor system. What this relationship is, will determine very largely what is the actual attitude of the individual toward the environment, and what are the mental needs upon which a true education for him can be based. What, in detail, this conception of mental structure involves, is best seen in a simple analysis of the different cognitive levels of the adult mind.

Defining cognition as a situation in which a subject finds himself face to face with an object which he recognises as something distinct from himself, and which therefore he can study and observe, we find that human cognition is not confined to that of objects of the outer world. A man is cognisant of his mental images, memories, and the like, of his feelings and emotions, of his ideas, concepts, and even of the principles governing his mental processes - so that even thinking itself is studied and a science of logic made possible.

But it is common experience that to be cognisant of one's mental imagery is easier than to be awake to one's more abstract ideas or conceptions. For to be fully cognisant of an object - to be completely aware of it - one must be able so far to dissociate it from oneself as to be able to judge it. We are all in the habit of judging the mental images which arise, as to whether they are clear or indistinct, whether they belong to reality or phantasy, whether they are healthy or unhealthy, and so on. An adult who did not continually make such judgments would no be normal. But fewer people are in the habit of thus judging their ideas and conceptions - of really objectifying their own views of the world or of life, for example. This is a rather more difficult act. It involves the subject taking a pace further back, as it were, and of focussing his attention upon something usually much closer to him, and which he is accustomed to take for granted. While a cognitive awareness of the logical and ethical principles in accordance with which we daily think and act is found almost exclusively among those who have made a special study of the matter.

It must now be noted that when an individual has trained himself to objectify and examine the various phenomena of his mental life - even those logical and ethical principles which stand behind the manipulation of the thoughts themselves - when, in other words, he has differentiated himself from all these, - there remains over the subject himself; and that, in such moments, although he has thus stripped himself of all his mental belongings, he is nevertheless still acutely aware of himself as an individual. If fact, no one experiences this sense of individuality more keenly than he who can thus stand as judge over against his own thoughts.

On the other hand, it is to be noted that the individual who is less accustomed to practise such mental objectivity, is of the type who tends to seek his feeling of individuality more in terms of a group or "herd" to which he attaches himself and with whose outlook he finds himself in sympathy. He clings, in other words, to groups of ideas or prejudices with which he closely associates - if not identifies - his own ego. In short, his real individuality is weak and seeks support from groups of more or less fixed ideas or beliefs.

Yet we must admit that a man may argue quite logically without being in the least aware of the principles which he is following, and be quite consistent in his moral judgments without knowing anything of the ethical theory in terms of which he is really making these judgments. Again, a man can possess ideas and conceptions - political or religious views, for example - and act in accordance with them, without ever so far objectifying these ideas as to judge them as he judges those of other people.

Descending still farther in the scale of mental objectivity, we come to the man who, as we say, "lives in his feelings", and tends to act more out of these than out of definite ideas. While he who is found to be living in his mental imagery is either a dreamer or a person bordering on insanity.

What, then, is the difference between our being aware of our ideas to the extent of judging the world in terms of them, and our judging these ideas themselves? In the latter case we make these ideas into objects of observation and judgment. We adopt a truly cognitive attitude towards them. In the former case we are also aware of them, but in a different sense. In what sense is this?

A useful indication is already given us in the expression "living in one's feelings". A man who lives in his feelings does so in that he does not objectify his feelings. For while it is true that a man who objectifies his feelings does not therefore cease to feel, - to feel is nevertheless one thing, and to know what one feels is quite another. For example, a person may be jealous without being aware that he is jealous. In order to know what one's feelings are, one must objectify them and pass judgment upon them. It is only by this latter process that we learn to inhibit certain acts which might result from our feelings. Conscious inhibition presupposes objective cognition of what is inhibited. But a man who "lives in his feelings" and acts accordingly, does not inhibit them. He is not sufficiently aware of them in the objective sense to do so.

This state of "living in" feelings is, of course, a form of cognition, if we use the term in a certain loose sense. Such a person is not unaware of his feelings. On the contrary, he experiences them acutely. But he does not pause to judge them from either a moral or a psychological standpoint. In order to do this, the ego must enter into a quite different relationship to the feelings concerned. It is preferable here to reserve the term "cognition" for this latter relationship; for it is of very great importance that we should clearly distinguish the one mental condition from the other.

Most of us, of course, fluctuate between the two states. We live in an intense emotion at one moment, and only afterwards contemplate it in retrospect, passing judgment upon it. This, of course, is not objectification of the emotion itself, but only of a memory of it. But in the case of lesser emotions and many forms of feeling, it is possible for us to turn our cognitive attention to them while they are still present, and to judge them quite objectively. For example, when a person says to himself: "Why am I feeling so depressed today? Is it due to my digestion?" he is not living in the feeling of depression at the moment, but is observing it from a quite objective point of view. Another person, on the other hand, might give himself up entirely to such a mood, never bestirring himself to reflect upon it, but allowing it to influence all his acts and thoughts.

Similarly we can - and do - speak of a man who lives in his ideas. This type may range from persons who tend to interpret reality in terms of preconceived ideas or opinions, to the fanatical type and pathological cases. The trouble in all such instances is, that the subject cannot get away from his ideas. He cannot live outside them and view them objectively. (This is to be distinguished, of course, from living _for_ an idea or ideal. This too may produce fanaticism, although the idea in such a case is an objectified one.)

The difference between the experience of living in feelings or ideas, and of objectifying them, is thus a difference in relationship of the ego to these feelings or ideas. In the one case the ego experiences the idea or feeling entirely, as it were, "from the inside". In the other case, the ego is able _also_ to experience it "from outside", i.e. objectively. Neither is a situation which can be "explained". It is sufficient to point to it and characterise it. In both cases the feelings or ideas are _experienced_, but in the latter case they are both experienced and judged. One might say that in the former case they are "lived" but not cognised.

It will be observed that the only thing which can never become an object - which can never be cognised but only "lived" - is the judging subject himself. We can experience our egohood only in this other sense - from "inside". Hence direct observation of the ego is impossible. We can observe in an objective sense only its overt acts. There is nothing "metaphysical" in thus characterising the ego. It is a perfectly legitimate psychological characterisation. The ego is an experience, not a postulate. Only, it is not a _cognitive_ experience in the meaning of the term here outlined.

It is just because of the quite unnecessary assumption that the ego must be objectifiable in order to be considered a legitimate datum of psychology, that characterisations of it have been sought in groups of ideas and sentiments, in the stream of consciousness, and the like. Groups of ideas and sentiments are not the ego, but what the ego has gathered round itself in the course of its experiences, and which, as already indicated, it may objectify and judge; while the stream of consciousness is that which passes in review before the ego. It is the stream in which the ego stands, as observer. How else could we know that there is such a stream at all? We can know that the river is flowing only if we stand still beside it or within it, and observe its movement in relation to ourselves. If we are one with the stream, we float down with it, and then we cannot observe the current. In short, if anyone speaks of a stream of consciousness, he admits that it is something he has cognised, - something which appears, as object, to him as subject; and in speaking of it as a cognisable object he already admits that it is not the subject. Such characterisations of the ego are merely the outcome of mental confusion.

The ideas, sentiments, and so on, with which the ego faces the world, may be regarded as the psychical "clothing" of the ego; and the ego is constantly changing its psychical clothes. So long as the ego wears these clothes, they may be considered as a part of the total self. They are accepted by the ego as representative of itself for the time being. But they must not thereby be confused with the individuality. For the ego can - and does - treat them as objects, and may even repudiate them after a time and cast them off.

The ego stands in this unique position that, because it can be aware of its own existence and identify only as a "lived" experience, it is dependent for self-knowledge upon the thoughts, memories, and so on, which surround it. It can learn to know itself, - i.e. what kind of being it is, - only by contemplating what it has done, both physically and mentally, together with the manner of thoughts, feelings, and emotions which it entertains. The more, then, that the ego can objectify those psychical elements which surround it and cling to it, the more self-knowledge it will acquire. It is for this reason that loss of memory brings loss of self-knowledge, but not the loss of any sense of personal identity. My memories are the mirror in which I see myself reflected; they are not me. I need a mirror in order to know the nature of my face, but my face does not cease to exist when the mirror is broken.

To sum up, our analysis has led us to distinguish between the human ego, and the mind in which it lives and through which it acts. It is not a group of thoughts and sentiments, nor the stream of consciousness, nor even, as James would have it, a single complex thought which is the final receptacle, owner and knower of all the previous thoughts. (4). To begin with, such a "thought" has no existence in psychological experience. A thought is something of which we are conscious. We are never conscious at any moment of all that we are, have been, feel, wish, will, and know. We could become aware of all this only in a series of many thoughts. Secondly, no thought "knows" another thought. We have no such experience. We have experience of a thought only as something that is known, or as something in terms of which some other object is known. And if it be argued (although it is begging the question) that each of us is, after all, just this final all-inclusive thought, there is no reason why this last thought should always be the knower, while, as soon as it is displaced by the one immediately following, it should thenceforth completely change its function, cease to be the knower, and become only the known.

Because the experience of egohood is a unique one, and because we do not know what the "I" is, are no reasons why it should not be a datum of psychology. A genuinely scientific attitude is prepared to recognise any datum, however unique or mysterious; and it does not help in the least to evade the issue by giving it the name of some other datum to which it bears no resemblance. We know what we mean by a thought, and we recognise one when we meet it in our psychical life. It is something which in itself is passive, and something which we can contemplate. But the ego is experienced as a centre of activity, and as something which we cannot contemplate. To call such an experience a "thought" is not only a mère postulate, but one for which there appears to be no foundation either in experience or in reason.

The fact is, that James does not avoid the fallacy of the "stream of consciousness" theory when he assumes that the last part of that stream is that which cognises the remainder. For the part - however ultimate in time - nevertheless flows with the whole; and he has still to face the question: What is that, which, in virtue of its not flowing, is able to recognize that a stream exists at all? The ego, in short, is not to be denied.

This analysis which we have made is not one of mere academic interest. It is, as will be shown, of the most fundamental practical importance, without which we can make no advance towards the solution of problems of education. For the educator must know at least two things, - first, where to point to the individuality, how to distinguish it from the merely ephemeral; and secondly, in what successive aspects it shows itself during the physical growth of the child.

We must now consider the relationship of the ego to its ideas at the various levels of cognition. We have seen that, for ordinary life, it is not necessary that the ego should become objectively aware of the principles according to which it thinks or acts, nor even of the ideas or concepts in terms of which it judges things and affairs. In other words, on such occasions, the ego need only "live in" such principles or concepts. It uses them, but need not objectify them.

For example, in the simple judgment: "That is a horse", we must possess the concrete idea of horse, but it is not necessary that one should be objectively aware of the idea and say to oneself: "I know that that is a horse, because I have already a concrete idea of horse". On the other hand, if one is asked to give an account of this or that kind of animal, one is obliged to bring under objective review a concrete idea of that animal. We should not, however, need to objectify the class-concept "animal". But if we are studying some low form of organism and are faced with the problem: Is this an animal or a plant? we must bring into objective review the concept "animal" and the concept "plant" and compare the two in relation to the object before us.

At each of these stages we must take a step back, as it were, and bring under objective review and judgment concepts or ideas which, at the more elementary levels of cognitive activity, we use more or less unconsciously. Thus the relationship of the ego to its concepts, ideas, and the like, is different at each level. It stands in an objective relation to some and ina "subjective" relation to others. At the lower levels the ego must at least possess the requisite concepts or ideas, but it need not objectify them. The higher the level of thought or cognition, the more it must stand in an objective relation to its concepts. Thus at each level we have an example of a different kind of mental relationship or "structure".

Now every normal adult can, potentially, operate on any of these levels. Even a principle of conduct or of reasoning, or a scientific law, is within his grasp if his attention be drawn to it and if he exert himself to understand it. But how does this matter stand with the child?

ANALYSIS OF STANFORD REVISION OF THE BINET SCALE

Let us examine first of all the Stanford Revision of the Binet Sclae, in which we shall find what the average primary school child is able to do at the various ages when not subjected to class-room pressure.

At 5 he is expected to: (1) Compare two weights, (2) Recognise a colour, (3) Distinguish between prettiness and ugliness in a picture, (4) Define an object in terms of use, (5) Recognise the similarity between two simple geometrical forms, and (6) Carry out a series of simple instructions. He is also expected to know his age.

In (1) we have an act of judgment of the most elementary kind, involving the power to compare two muscular sensations.

(2) is an act of naming.

(3) is a comparison of an aspect of two things.

(4) involves a statement derived from past experience. "A fork is for eating with" is hardly a judgment based on thinking. It involves memory rather than thought. The child has seen forks, horses, pencils, etc., being used, or he has used them himself and already knows what he does with them, or what other people do with them. His task is here to objectify a memory-image of a total situation, and not to allow himself to be led from the point by the power of association, - not to reply, for example, by naming an associated image in the situation and say "A knife" in reply to the question about the fork, nor succumb to the imitative tendency and simply reply "A horse" to the question "What is a horse?"

In (5) - "Divided Card" - the child tries various positions of the two pieces until he is satisfied that their combined shape is now like that of the other card. The test is therefore one of comparison of an aspect of two things in the visual sphere, together with a certain test of the power of persistence.

(6) is a test of attention to words, the power to transform them into imagery, and to retain this series of images in order.

Thus three of these tests involve comparisons between qualities in observed objects, or the ability to objectify muscular sensations, visual sensations of form, and elementary aesthetic feelings.

The colour test is of a different order. It too involves the objectification of a visual sensation, but it also belongs to the "naming" type of test (as at age 3), with this difference, that the child is asked to name, not objects, but abstracted aspects of objects. Colours belong to the objects of his experiences, and to place before him four colours in juxtaposition and to ask him to name them, is to present him with a slightly unusual situation. Apart from this element of naming, however, this test is substantially of the same type as the three already mentioned, involving comparisons between qualities of a sensory or affective kind.

The remaining two tests (Definition in terms of use, and Three commands) point to a consciousness of imagery, to a certain objective relationship to it. But there are three kinds of relation to imagery,- that of merely observing it, that of abstracting from it or controlling it, and that of manipulating it, - all of which may be said to involve an "objective" relationship to it. In the first we merely attend to an image, reading-off what is there, as in the description of the function of a horse, etc.. In the second we abstract from it, and in the third we transform it. It is only the first stage which is here in evidence.

It is to be noted that at this age the child is not asked to cognise objects, <u>as such</u>, but certain aspects, qualities, or functions of the objects; and in the two tests involving memory he is expected to cognise only an image of a total situation of which the object named is only a function. He is not yet expected to select an object from that situation and cognise it in abstraction from other objects. In test 4 he has to cognise an image, not of a horse in abstraction, but of the total situation of "horse-pulling-cart", or "man-riding-on-horse"; a fork is "a-fork-in-my-hand-while-eating-my-dinner; a table is "table-in-the-room-at-home-with-things-on-it", and so on. Likewise in test 6 he has a series of three situations: "Key-to-be-put-on-seat-over-there", "Open-door-to-be-shut", and "Ink-bottle-over-there-to-be-brought-here". The cognising of an object in abstraction from its natural context, whether physical or in imagery, involves an act of thought which is not expected of the child until he is 6.

The alternative test - giving age - has little significance beyond evidence of memory for verbal statements which the child has heard made about himself. It points to a certain control over memory as in test 6.

Coming now to the tests at year 6, the first is that of a knowledge of the terms "Right" and "Left". Of the four reasons given by Terman (5) as to why Right and Left are discriminated by the child later than up and down, and before and behind, the most cogent appears to be that of the frequency with which the two latter are used by the child in comparison with Right and Left. Right and Left are not vital distinctions for him, and they are not forced upon him as the others are. Further, those other distinctions are concerned with dimensions in space, while Right and Left are, primarily, distinctions in the child's own body. It is easier for the child to cognise a distinction which is outside him, than one which is more closely bound up with his own person. Cognition of self comes later than cognition of the environment.

But, when awareness of this difference does arise, it is apparently a matter of a certain feeling of difference - almost an organic sensation - between the one side of the body and the other. It is in terms of this feeling of difference that the more abstract relation of right and left in outer objects is later judged. This bodily experience appears to be a unique one, and cannot be compared with any other type of apprehension.

Test 2. (Omissions from pictures). To recognise an object and name it, involves the use of an idea in the light of which the object is recognised. But if a child fails to see that parts of the object are missing, even when it has been suggested to him that there is something wrong, this can only mean that he is projecting his preconceived idea upon the object and so filling in the missing parts. This means, in other words, that he is not free of the idea, but is living in it to the extent that it dominates his visual perception. This fact comes to light only in such a case as this, where the object has to be not merely recognised but criticised.

In this test, as Terman points out, (p. 179) "the parts of the picture must be perceived as constituting a whole", and thus we have the use of the category of "whole and part" in connection with an object. But a much more important factor is the ability on the part of the child to free himself from the idea. This test primarily involves, therefore, the use - but not necessarily the conscious objectification - of a free idea in terms of which the judgment is made, together with the ability to distinguish this idea from what is actually seen. To name or recognise an object need be no more than an immediate associative reaction. Here, however, such spontaneous association must be inhibited and judgment take its place. We have here a sign that the child's ideational system is passing under the control of the ego.

> Of younger children Terman says (p. 180): "The writer has found that normal children of three years often see nothing wrong in a picture which shows a cat with two legs or a hen with four legs. Such children would, of course, never mistake a cat for a hen.

> Their trouble lies in the inability to call up in a clear form a "free idea" of a cat or a hen for comparison with the perceptual presentation offered by the picture."

But in the present case there can be no question of there not being adequate ideas. Every child knows the appearance of a human face; and the child who fails in this test does so - not because the idea is not called up, - but because of the relationship which the ego has to that idea.

At six, apparently, this relationship has changed for the average child; and we have in consequence the first appearance of the ability to apprehend an object as something which can be examined and judged, - which is the ability to apprehend an object in abstraction from the environment.

Test 3, - the counting of 13 pennies, - does not appear to be one of great psychological interest. If a child can cognise an object, and if he has learned the use of numbers, there appears to be no reason why he should not count 13 pennies. But the test does not show decisively whether or not the child has grasped the meaning of number.

Test 4, "What is the thing to do if it is raining when you start for school?", etc., - is a test of comprehension. The child is asked to call up a concrete situation and to describe what his acts should be in regard to it. But it need involve no more than the awakening of a memory image of such an incident and the retailing of what was actually done on that occasion, or of what he has been told is the right thing to do. There need therefore be no question of any form of reasoned judgment in the response to this test; but there is certainly involved in it the ability to attend to the image of a concrete situation, and to give an account of that image.

Test 5, - the naming of four coins, - involves the recognition of an object with a certain degree of accuracy; and test 6, - repetition of 16 syllables, - is again a test of imagery-fixation.

The alternative test, - "Morning and afternoon", - involves the retention - or calling up - in memory of the events of the day, and the recognition of the immediate events in the light of an idea of time. We have here again the use of a free idea, for there is no environmental stimulus which could evoke an automatic response. Attention to imagery is also involved.

To sum up this series, the only tests which indicate anything new in the mental powers of the child at this age are, "Distinguishing right and left","Omissions from pictures", and "Morning and afternoon". The first, as was pointed out, stands by itself. The remaining two indicate the use of free ideas, and the emergence of the ego from a "subjective" relationship to ideas. The third also shows the beginning of an idea of time. The other tests show merely an increase in abilities already possessed.

Although the question of the pre-school child is outside the bounds of the present inquiry, it is necessary at this point to consider briefly the tests for 3- and 4-year-old children in order to distinguish the fundamental characteristics of these tests from those with which we have just dealt.

At age 3, in tests 1, 2, and 3 the child is asked to point to an object, (nose, eyes, etc.,), name an object (key, penny, etc.), and name objects in a picture. This recognition of objects to which he can attach names is not to be confused with "cognition" of an object by the child in the sense already discussed. It is the recognition of parts of his environment in the light of previously acquired ideas; but it in no way demands the use of a free idea, together with its implications.

Tests 4 and 5, - giving sex and family name, - have to do with a recognition of self. The former involves the use of an idea - however vague or incomplete, and the latter the use of a name which he has learned belongs to him. The principal factor required here is a certain ego-consciousness. The remaining two tests (6 and the alternative) involve repetition of words or digits. Thus the mental level at this age would appear to be a sense of self-hood, and the recognition and naming of objects.

At age 4 we have three tests which are concerned apparently with visual discrimination of spatial relationships, namely, comparison of two lines, discrimination of forms, and copying a square. From the point of view of adult cognition these tests are of the same order as that of the divided rectangle or any other test involving recognition of a geometrical form. But there is a factor in the presentation of the second test which is of importance to the child - that of the examiner running his finger round the outline of the forms. This does not merely draw the child's attention to the outline; it presents the form to him in the aspect of movement. The child is still in the imitative stage when movement makes the strongest appeal, and the comprehension of a form in terms of movement is probably much easier for him than comprehending it as something static.

Copying a square involves the actual dynamic representation of a figure on the part of the child, but here the instructions are not to run the finger round the four sides. This is further complicated by the element of motor co-ordination in the use of the pencil. The scoring here, Terman says, (P. 155) "should be rather liberal". The comparison of the lengths of the two lines is a very simple act, and, as Terman points out (p. 151) is more a matter of understanding the verbal directions and of degree of attention than of discrimination of length.

According to Terman (p. 158) the purpose of test 5 (Comprehension) is "to ascertain whether the child can comprehend the situations suggested and give a reasonably pertinent reply." But it is surely of importance to consider also what is the source of a reply, however pertinent it may appear verbally. A reply may be based on (1) Verbal association, (2) Comprehension of the situation in imagery but where the conduct referred to is based simply upon past experience, (3) Comprehension based upon reasoned insight. Verbally, all three responses might be alike, or equally pertinent. For example, of two correct replies quoted by Terman in answer to the question; "What must you do when you are sleepy?", one - "Have my mother get me ready for bed", - suggests comprehension of the situation; whereas the other - "Lie still, not talk, and I'll soon be asleep", rather suggests the more or less verbal repetition of a maternal injunction; for if the child were really sleepy he would not need to think about lying still and not talking.

Thus two replies which may be verbally adequate may nevertheless represent two qualitatively different psychological situations. The first involves the subject seeing the suggested situation in imagery and taking up an objective attitude toward it, selecting therefrom the essential factors. The second appears to be the outcome merely of association, the response not being selected, but "selecting" itself. Such tests tell us nothing of the mental structure of the child unless the questions are such that they plainly exclude the possibility of responses at the lower levels. But in the present case any of these levels might be operative, and so the significance of the test is doubtful.

Tests such as test 6 - repeating of four digits - appear at first sight to be in contrast to the foregoing, as a type which merely increases in degree of difficulty. But there are two ways of repeating digits or words which have just been heard. A number, for example, can be repeated mechanically, by mere echoing; but if it is desired to retain it in memory for even a short period, it is necessary to form an actual mental image of the number. It is a common experience, for instance, that, when told a telephone number, we repeat it mechanically without forming an image of it, and immediately afterwards we are unable to recall it. Unless we pause deliberately to form a mental image of the number, or keep repeating it to ourselves, we shall have forgotten it by the time we reach the telephone.

The echoing tendency of the young child is adequate for the repetition of numbers or words in this first way; but there must come a point at which the numbers or words become too long or numerous to be repeated mechanically, and the deliberate formation and retention of a mental image becomes necessary. Apparently the limit of this mechanical method for the young child is reached with four digits; for while three digits can be repeated at 3 years, and four digits at 4 years, five digits are not introduced into the scale until 7 years - three years later. We have already seen that at 6 the system of ideation and imagery is beginning to pass under the control of the ego, which is a factor necessary to the deliberate formation of mental images. The repeating of digits, therefore, does not always represent the same type of mental structure. At ages 3 and 4 it would appear to be still a mechanical process, otherwise there seems no reason why the repetition of five digits should have to be postponed until age 7.

The remaining test - counting four pennies - is also psychologically unsatisfactory. Terman (p. 154) points out that success "does not presuppose any power of calculation or a mastery of the number concepts from one to four." But when these are excluded, what is left? It is a bare reference of a number (not understood) to an object (not yet grasped as such).

To sum up this 4-year-old group of tests, we have evidence for some form-discrimination and motor co-ordination, but evidence of ability to objectify imagery is doubtful.

Returning to our analysis of the tests for children of school age, we come to year 7. At this stage of the analysis we must begin to distinguish two types of test, - one type in which the mental structure required is the same as that seen in a previous year, the test being more difficult only in degree, - the other type consisting of tests for which an entirely new mental structure is required. This latter type of test we shall call a "significant" test.

Taking the abilities of the 5-year-old child as a basis, at which stage he can objectify and compare certain sensory and affective elements, and objectify an image of a total situation, we find at age 6 two new functions appearing, - the cognition of the feeling of "right" and "left" in his own body, and the cognition (through the use of a free idea) of an object as such. All the remaining tests involve functions already at the command of the child and are not "significant". For example, when a child of 6 is asked to visualise a situation in which it is raining when he starts for school, he is merely carrying through a slightly more complicated variant of what he already did at the age of 5 when asked to describe a horse. In the case of the latter question his problem is, in effect: "What does a horse do?" In the case of the former it is: "What do I do when it is raining and I am starting for school?" The mental structure is the same, - that of the ego confronting the image of a total situation and expressing what it observes.

All the tests at 7, on the other hand, appear to be significant with the exception of "Picture description". This test, of course, involves a different function from that of mere enumeration. It involves, however, the perception of objects in a meaningful relation - which the child of 6 already does when he pictures himself in a concrete situation, and even the child of 5 when he describes the functions of things. Hence there is no reason why such a test should not be passed at 5 or 6, if the pictures are simple or obvious enough. Terman (P. 193) remarks that with pictures used by Kuhlmann "even 5- or 6-year intelligence seldom fails with them." And he adds: "No better proof than the above could be found to show how ability of a given kind does not make its appearance suddenly. There is no one time in the life of even a single child when the power to describe pictures suddenly develops. On the contrary, pictures of a certain type will ordinarily provoke description, rather than enumeration, as early as 5 or 6 years; others not before 7 or 8 years, or even later." This proves nothing, however, beyond the fact that this type of test is not a very significant one. It could also be said that there is no time in the life of a child when he cannot repeat digits.

Coming now to the significant tests at 7 years (1) - Number of fingers - shows a grasp of the use of number which was not clearly seen in the counting of 13 pennies. It is a conception of number, however, still attached to the concrete.

(3) - Repeating five digits - as we have already seen, appears to depend upon the development of control over imagery, and so represents a new factor.

(4) - Tying a bow-knot - chiefly involves, according to Terman, (p. 199) "Interest in common objective things" and "Ability to perform permanent associative connections between successive motor co-ordinations (memory for a series of acts)" The significant element in this test appears to be, however, not interest in objective things, for that is already present at 6 in the ability to cognise an object, but in the fact that we have here a series of acts too complex to be performed by mere imitation, but only through conscious direction by the ego in the light of an objectively grasped series of images. At 6 we saw that ideas were beginning to pass over to the control of the ego. Here we

see that the ego is beginning to control, through such images, the motor system in a conscious way.

In test 5 - Concrete differences - we have the calling up of two concrete ideas and an act of comparison between them. In "Omissions from pictures" a comparison is made between an idea and an object. Here it is between two ideas. In this respect it is a different quality of test. The child must be aware of his ideas; whereas, in the 6-year-old test, the image-pattern of the human face to which the child must refer in making his judgment is not consciously apprehended as such. Even as adults we are not consciously aware of the ideas in terms of which we make such comparisons. In short, in the 6-year-old test we have the objective cognition of an object. In this test we have the objective cognition of concrete ideas in its first beginnings - apprehension of an aspect of two ideas; for the child compares only a quality common to the two ideas, as he compares qualities common to two objects at 5.

Test 6 - Copying a diamond - would appear to be a further stage of the test of copying a square; but, like the digits test, a new factor is involved other than one of degree. The shape is abstract, and one outside the child's normal experience. Square or rectangular forms surround him on all sides, but here is a shape upon which he must fix his attention and note the unusual direction of the lines. He must, in fact, treat it as an object - see it as it really is - and not yield to the associative tendency by drawing a linear figure he already knows. This he should be able to do at 6; but the factor of control over the motor system which appears at 7 in the bow-knot test, is probably an important one here. To be awake to the form of the figure is not enough.

He must have sufficient motor control to reproduce it. Hence there is an interval of three years between the square and the diamond test.

Of the two alternative tests, the second, - Three digits backwards, - is especially interesting. Here the child must not only observe an image, but he must mentally re-read it in the reverse direction to that in which it was built up. Terman calls this "manipulation" of imagery; but it is hardly that. The image is not moved or changed. It is merely "held" or controlled. The first alternative - Naming the days of the week,- including the answering of the "check" questions, involves also this ability to read backwards and forwards from some form of image or series of images, as well as a certain conception of time.

These significant 7-year-old tests show that the child has now the ability to objectify concrete ideas and to control mental images which do not form part of a total situation, and that he has a grasp of the use of number in the concrete. It is a most important stage in his mental development.

We have now observed three stages of development in the relation of the ego of the child to its imagery and to concrete ideas. At 5, concrete memory images in a context - a total situation - can be objectified and observed. At 6 an image can be abstracted from its context - in the form of a concrete idea - and used for the purpose of comparison with an object. At 7, these ideas can themselves be objectified and compared with each other, while abstracted mental images can be fixated.

In the 8-year-old tests there are three which appear to show a new mental structure, involving the objectification of complex ideas, or concrete ideas in relation. These are, "Ball and field", "Similarities" there already supplied for him, and he had nothing to do but "read off" the answer. Here, however, he must either grasp the related ideas as such, or fail to answer correctly. The questions are concerned with what ought to be done, and so cannot be answered merely de facto.

But although the child objectifies these ideas in relation, it does not mean that he objectifies the abstract relations themselves, such conceptions as ownership, etc., in the abstract, belonging to a class of concepts which are not found to be objectified by the child until the age of 12. We may therefore say that at the age of 8 he uses or "lives in" such concepts, but does not objectify them.

The middle question, about being late for school, seems quite out of place here. Psychologically, it is of the same quality as the question at 6, about what to do when it is raining. It is a purely practical matter, and can probably in nearly every case be answered from memory. Its main difficulty appears to the writer to lie in the fact that the child might well think the expected answer too obvious to be the right one. It is noteworthy that Burt (6) inserts the question about "missing a train" in its place, which, according to Terman, is a 6-year-old test.

In regard now to the non-insignificant tests at this age, "Definitions superior to use" - in so far as these are merely descriptive - are evidence of a slight advance in the ability, shown at 7, to objectify a concrete idea. Here the idea is cognised more as a whole; and, as the idea is described in terms of parts related to a whole, we have the use of the category of "Whole and part" in connection with a concrete idea.

In so far, however, as the answer is a "class" definition, we have the use of such a concept in connection with a concrete idea. But this stage belongs probably to a year later. Bobertag (7) shows in his table of answers to these questions that true class definition does not appear until 9, while Burt (6) obtained only 63.8% passes at 9, even when including description. In Burt's table of age-assignments given to the Binet tests by the different investigators, it is noteworthy that out of 17 of these, 15 place this test at either 9 or 10 years, the only exceptions being Terman at 8, and Rogers and MacIntyre at 12.

Counting backwards, from 20 to 0, is a rather more difficult form of the 7-year test of repeating digits backwards. It is, however, the same psychological process, involving a firm grip of imagery and sustained attention. Terman (p.214) says that the quantitative relationships of the numbers must be apprehended. It seems rather, however, to need primarily some imagery of the number series, and, given this, the apprehension of the quantitative relationships becomes a secondary matter. At the very least, it involves the "holding" of one number in imagery until the next lowest is found.

What exactly the "vocabulary" test signifies could be known only through an examination of individual responses. The words are so heterogeneous, and the accepted levels of definition so various, that it is impossible to generalise from it. Further, the range of words with which a child is acquainted is so much a reflection of his environment, that we have no means of knowing how far we are really testing the child's native intelligence.

Of the two alternative tests, naming six coins is a more difficult form of the similar test at 6, and so involves nothing new in structure;

while "Dictation" is too involved in the scholastic element to allow of our making any psychological deductions from it.

To sum up, this year shows a complete cognition of concrete ideas and of concrete ideas in relation, the relational concepts themselves, however, not being objectified but only used. Similarly we can say that the child now uses what may be called "general ideas" or"rules of conduct" in connection with concrete ideas, - that governing the "Ball and field" test being of a practical nature, and those governing the two "comprehension" questions being of an ethical nature. But, like the relational concepts, they are not yet objectified.

In the 9-year tests we find this use of relational concepts further extended. In giving the day, date, and year the child must bring three separate temporal ideas into relationship with one another; and in the "Five weights" test he must bring into a serial relationship the weights of the five objects, - i.e. he must be able to use the concept of a series. The third test, - "Giving change", - again involves ideas in relation, this time the relationship being one of reciprocity.

Thus these three tests represent the use of a temporal, a serial, and a reciprocal relation, and we have to do with the same mental structure as at 8, the difference being, presumably, one of difficulty in degree.

The repetition of four digits backwards is of course a further stage of the same test at 7, and involves nothing new in structure; while naming the months involves the same mental process as that of naming the days of the week. Knowing the value of stamps has its basis in a knowledge of coins, already possessed at 8, and simple arithmetic.

"Finding rhymes" - as Terman points out (p. 249) - "means that one must hunt out verbal associations under the direction of a guiding idea". This involves the child "holding" an auditory image, and searching among his memory images for the appropriate association. It involves attention, and the power to move freely among his images; but this demands nothing new in structure.

The only remaining test, "Sentence-building", - needs some discussion. The task of building up a sentence including three given words involves bringing these three concrete ideas into a relationship. It is the unity of the resulting complex idea rather than the grammatical unity of the sentence which is required here; for sentences consisting of two independent clauses are accepted. The mental level of the test, however, will depend largely upon the nature of the idea required, and which will of course vary with the words given.

At its simplest it involves the cognition of related concrete ideas, e.g. "The boy lost his ball in the river" (quoted by Terman). But "The river is a source of much money to London" (Burt) from the words "London, River, Money", is obviously a combination of a much more abstract kind. This is largely because these three words do not lend themselves so readily to such a concrete linking, although the words themselves are concrete. Thus the difficulty of this test will depend not only upon the concreteness or otherwise of the words themselves, but upon their intellectual "distance" from one another. Yet Burt (6) is also willing to accept: "London is a big place. It has a river in it. And many people come there to make money." Taking Terman's conditions, however, it involves at least the cognition of a complex idea consisting of concrete ideas in relation.

This test, however, differs from the other relational tests in one particular. In the previous tests, - even in the "ethical" comprehension questions, - the relationship already existed and had only to be apprehended. Here, however, the relationship has to be invented. This involves manipulation of the concrete ideas and would appear to beaqualitative advance on the 8-year level. But while this might safely be said in regard to the "London, River, Money" test when a single sentence is demanded, it can hardly be affirmed of "Boy, Ball, River" or of "Work, Men, Money", since mere association of ideas may here be operative. Such sentences as "The boy threw his ball into the river" or Men work for money" may fall into place almost automatically in the child's mind, and in which case it is scarcely a test of anything. Like the vocabulary tests it is vitiated by the factor of environment,- by what the child is in the habit of doing or hearing.

There is therefore no clear evidence here of any mental structure in advance of the 8-year level; and we have to conclude that the difference between the 8- and the 9-year intelligence is not a difference in structure but only of greater ability in the use of the structure already possessed. In other words, there are no significant tests at this age.

Of the six tests and three alternatives at 10, six prove to be non-significant. The vocabulary test provides no general information, as already pointed out. The naming of 60 words in three minutes is again a test whose results can be judged only in individual cases. Its psychological significance depends entirely on whether the child proceeds in an orderly way to enumerate words belonging to a class of object, and, having exhausted these, passes to another group; or, whether he passes, through quite illogical association, from object to object indiscriminately. A scatter-brain might well succeed by the second method.

Reading for eight memories involves no new factor, as does neither the repetition of six digits nor twenty-two syllables. The third alternative test, - that of the Healy and Fernald form-board, - involves space discrimination and some elementary reasoning, neither of which is a new element at this stage.

In the tests of "Absurdities", "Memory drawing", and in one of the "comprehension" questions, we have, however, a new factor appearing.

Absurdity usually involves some form of contradiction. To recognise a contradiction one must be conscious of some universal rule which is hereby broken. For example, roads cannot run both uphill and downhill at once, weight cannot add to the speed of a train, etc.. The child who passes this absurdity test must be able to objectify such general ideas.

A complex idea is the term we have applied to an idea of a related group of objects. A general idea, on the other hand, is the idea of a rule or law relating to such a group of objects and in terms of which (and of others) the group may be said to form a rational whole. If, therefore, we introduce into our idea of such a related group, another idea or related group of ideas which does not conform to this rule or law, an "absurdity" arises.

The "intruding" ideas are not necessarily absurd in themselves. In their proper context they may be perfectly rational. The absurdity arises through the clash of incompatible rules, or the juxtaposition of two incompatible wholes of ideas.

Thus we can say: To fail to see a contradiction or absurdity is to fail to grasp the fact that two factors in the situation are said to belong to a whole in which, however, they cannot co-exist. The absurdity lies in the affirmation that they belong to one whole, when actually they can belong only to quite separate wholes or situations. A girl may kill herself. A girl may be found cut into eighteen pieces. But the two facts cannot co-exist as parts of the same situation.

The ability to pass this test, therefore, involves not only the objectification of general ideas or rules, but the ability to distinguish separate groups of related ideas within a given context. This means the objectification of complex ideas in relation - in its simplest form - in which the relation is one of incompatibility, or exclusion.

It is interesting to note that the test of "Memory drawing" involves the same factor, - the apprehension of related wholes. Terman says (p. 261): "Success is possible only by grouping the lines according to their relationships, so that several of them are given a unitary value and remembered as one." and "Ability to pass the test indicates the presence, in a certain definite amount, of the tendency of the contents of consciousness to fuse into a meaningful whole."

This, however, is to grasp such a relationship only on the visual level, and it is on that account a simpler task than on the level of related ideas - as is the case in the absurdity test. The fact that this memory test is placed at the same age-level must therefore be due to other factors. It is thus not a wholly significant test for this age, but it is nevertheless the first appearance of such a type of test in this scale.

Coming now to the Comprehension test, we shall deal first with question 3, - "Why should we judge a person more by his actions than by his words?" In two of the comprehension questions at 8 the child was asked to make a judgment. Here he is asked to make a judgment about a judgment.

A simple judgment is made in the light of a general idea or rule which is used but not objectified. But here the rule must be objectified in order to answer the question: "Why do you make such and such a judgment?" The child must examine, not the judgment, but the rule in terms of which he makes the judgment. Hence we have again the objectification of a general idea or rule.

But questions 1 and 2 of this series do not demand this. They ask "What ought you to do?" - not "Why?". They are therefore of the same type as questions 1 and 3 at age 8. They are placed here, apparently, not because of any higher mental level which they involve, but on account of some greater difficulty in degree. "What ought you to say when someone asks your opinion about a person you don't know very well?" and "What ought you to do before undertaking something very important?" are questions in no way different in the mental structure which they demand, from "What's the thing to do when you have broken something which belongs to someone else?" and "What's the thing for you to do if a playmate hits you without meaning to do it?" All four demand an answer in relation to a concrete situation. They do not demand the statement of a rule. The fact that the word "ought" is substituted for "the thing to do" does not alter this fact. But the answer to the question: "Why should we judge a person more by his action than by his words:" must be the statement of a rule; e.g. "Actions speak louder than words" or "It's not what you say but what you do, that counts." (quoted by Terman, p. 270).

It is to be noted, however, that the rules or general ideas objectified at this age are of a factual nature, not ethical.

Summing up our analysis of the 10-year level, we have the objectification of simple factual rules, or general ideas, and the cognition likewise of complex ideas in relation. In connection with the latter, also, we may note the use of the category of "whole and part" in relation to complex ideas.

While this age shows this important step in mental development, the ability to objectify abstract ideas has not yet appeared, still less the objectification of "principles" or categories. Here, however, in the absurdities test, we see a principle in use, - the principle of "law" or "coherence" in connection with ideas of a concrete kind. It is at this stage, therefore, that we might begin reasonably to speak of the "germs" of the scientific spirit appearing in the child.

In the tests at age 12 we have four which are plainly a continuation of those given in previous years, namely, "Vocabulary", "Ball and field", "Five digits backwards" and "Similarities", and which therefore show us nothing new on the side of structural development. The significant tests appear to be: "Definition of abstract ideas", "Dissected sentences", and "Fable interpretation".

In the first, we have now the objectification of abstract ideas. In order to define a thought we must first be able to objectify it mentally.

In "Dissected sentences" we seem to have evidence for the ability to manipulate concrete ideas, since success in this test involves bringing the "broken" parts of the sentence into various relationships until the correct "whole" is found. But, as in the case of "sentence building", it is not easy to separate this from the association factor, and its real value therefore depends upon the degree of unusualness of the sentence. At the least, it involves the cognition of concrete ideas in relation; but how far the element of manipulation enters in, will depend on the sentence and the manner in which it is broken up.

This test, in fact, is merely a more difficult form of sentence-building, where, instead of a free choice of the intermediary words, all the words are given and have to be fitted into the sentence, without deduction or addition.

It is significant that of 13 investigators quoted by Burt (6) (P.212 10 place the sentence-building test (two sentences) at either age 10 or 11 (7 at 10 and 3 at 11), only 1 placing it below 10. As this applies to Binet's original test ("Paris, River, Money") or its local equivalent, and which are not normally "associable" words for a child, we may not be far wrong in placing the beginnings of idea-manipulation at age 10, regarding the "dissected sentences" test as merely a further development of it.

In "Fable interpretation" we have now the objectification of ethical rules, or general ideas of a non-factual type. The "moral" of the story has to be objectively cognised by the child.

In regard to "Picture interpretation" there would appear to be some doubt. Terman (p. 305) strongly reasserts that everything depends upon the nature of the pictures used, and that Kuhlmann's pictures are as easy to interpret at 10 as the Stanford pictures at 12. But while this is undoubtedly a level of thought which we have not yet met in connection with these pictures, the process is little different from what we have already assumed to be operative at 10, namely, the manipulation of concrete ideas. For, instead of the child being confronted with three concrete ideas such as "London, River, Money", which he has to manipulate into a rational relationship, he is here given a picture depicting certain persons and objects which he has to manipulate in the same way into a meaningful relationship. Like the sentence-building test, the difficulty or otherwise will depend upon the readiness with which these data are naturally associable for the child. It is a test which has comparatively little meaning; and one can imagine a picture being successfully "interpreted" by quite a young child if it happened to call up in his mind a story or event which he had recently heard or seen. We have no means of knowing whether the result is the outcome of deliberate idea-manipulation, or of mere automatic association.

The 12-year level can therefore be summarised as that at which the child can objectify abstract ideas and ethical rules. These are the only new mental abilities shown by the tests.

We may now make a summary of our analysis of the years 5 to 12.

TABLE 1.

Age:	5	6	7	8	9	10	12
Cognition of:	Aspects of Objects	Objects distinct from a Context	Aspects of Concrete Ideas	Concrete Ideas		Complex Ideas in Relation	Abstract Ideas
	Imagery of a Total Situation	"Right and Left"	Single mental Images	Concrete Ideas in Relation (Complex Ideas)		General Ideas or Factual Rules	Ethical Rules
Use of:	Concepts of Quality in reference to Objects	Free Concrete Ideas	Concepts of Quality in reference to Concrete Ideas	Abstract Ideas as Concepts of Relation			
				General Ideas or Rules			
			Number in reference to Objects				
		Category of Whole and Part in reference to an Object		Category of Whole and Part in reference to a Concrete Idea		Category of Whole and Part in reference to Complex Ideas	
The following may also be noted:	Control of Total Imagery		Control of Free Images	Control of Free Concrete Ideas		Manipulation of Concrete Ideas (?)	

Before drawing any final conclusion from these results, however, we must take account of the Revised Stanford-Binet Scales (Forms L. and M.) recently published (8). In these scales some of the former tests have been moved to other years, while some appear in other years in a modified form. Others, again, have been omitted and tests of a quite different type make their appearance.

We shall deal first of all with those tests which are the same as, or similar in type to, those of the 1916 revision.

As the ages below 5 are now divided into half years, it is to be expected that some of the 5-year tests, for example, should now be found at 4;6, since, in the old scale, the passing of all the 4-year tests and half of the 5-year tests gave a mental age of 4;6. Thus we have at 4;6 "Aesthetic comparison", "Three commissions" in Form L., and a kind of "definition" test expressing "use" - or an "identifying" description rather inferior to use, in Form M..

On the other hand, there appear in the 5-year tests, Form L., three which belonged formerly to the 4-year level, namely, "Copying square", "Repeating 12 syllables", and "Counting four objects". The first is scored as before, the second has a slightly higher standard (1 out of 2 as compared with 1 out of 3), while the third has a lower standard (2 out of 3 as against 1 out of 1). At the same level are now found two tests which were formerly at a later age, - tying a knot (Forms L. and M.) being a simpler form of the bow-knot at 7, and, (Form M.) a new form of the "Mutilated pictures" test at 6. In the latter the standard of scoring is lower (3 out of 5 as against 3 out of 4). There is also a

"Concept of number" test (Form M.) going as far as the concept of "three".

At year 6 (Form M.) we find a "Concrete differences" test which was formerly placed at 7, and a concept of number test (L. and M.) reaching to 10, in addition to the former "Fingers" test which remains at 7.

At 7 we find "Similarities" and the former "Comprehension" test (L.), both previously 8-year tests, "16 Syllables" (M.) formerly year 6, and a simpler form of "Sentence-building" than the one found previously at 9.

We have therefore a few changes to note. Although the "Fingers" test and a concept of number test appear at 7, the presence of the latter type of test also at 6 now indicates that the beginning of the use of number in the concrete is to be found at this age. Previous to this, there is only the "Counting four objects" test at 5 (L.) and a number concept test for "three" at 5 (M.). The gulf between these and the test at 6 is marked, and indicates that a big step forward in the conception of number is taken during this year interval. Any conception of number indicated by the 5-year tests is negligible.

Since "Concrete differences" is now placed a year earlier, the ability to objectify an aspect of two concrete ideas must now be considered to be present at 6. In the same way, as the "Comprehension" and "Similarities" tests are now placed at 7, we must place full objectification of concrete ideas at this age instead of at 8, as well as the beginning of the cognition of ideas in relation. The test of "Definition superior to use" has been dropped, but the ability to cognise concrete ideas wholly, and not merely in part, is involved in these two other tests.

These two alterations appear to be reasonable, since, if control of free imagery is possible at 7, there seems no reason why concrete ideas - which are very closely allied to the free image - should not be fully objectified at the same age, with partial objectification a year earlier. It is a more logical arrangement than that derived in Table 1. Mutilated Pictures, also, involving the use (not objectification) of a concrete idea - which now appears at 5 - suggests that cognition of an object should be placed at this age instead of at 6.

But this question of placing a test earlier by reducing the standard of scoring, is one which must be carefully considered from our point of view. The structural changes with which we are dealing do not take place over night. There must be a period of transition during which a certain task, involving a new structure, can sometimes be performed successfully and sometimes not. What we are concerned with, however, is the point at which we can say that the new structure is clearly there - not merely half there. Unless, therefore, the presence of other tests in the same year affirms the existence of the particular structure, the mental act must be performed by the child in, say, two out of three attempts at the very least, before we can say that the particular structure is now part of the normal mental life of the child. Three out of four would be a more reasonable proportion. For unless the child can perform a given task easily, allowing only for a possible slip, - (provided always that the difficulty of the test is not one merely of degree and that it represents the simplest of its kind requiring such a structure) - it would be wrong to base educational assumptions upon the fact, and to give the child scholastic tasks which involve such a structure.

The score in the "Mutilated pictures" test at 5, therefore, being only 3 out of 5, is too low for us to assume that cognition of objects is yet fully present at this age, although its beginnings may be noted.

It will be noted also that this line of demarcation affects the two significant tests at 12 in the 1916 Revision, namely, "Abstract definition" (3 out of 5) and "Fable interpretation" (4 out of 10), there being no other tests at this age to confirm this new structure. These are, however, the only examples of their kind in that scale, and we must wait for their confirmation, or otherwise, in our analysis of the new scales.

Tying a simple knot shows the first beginnings of the passing of the motor system over to the control of the ego, which reaches a certain completion at 7 through the ego's control over imagery. This test is very different from the bow-knot test (formerly at 7 and now discarded); for it requires actually only the same simple movement repeated twice in order to form a simple knot. This hardly shows the control over a series of images indicated by the bow-knot test.

On the other hand, the "Days of the week" test is now postponed until 8. As this test involves control over imagery such as is shown by other tests at year 7, both in the new and in the former scale, it is difficult to see any psychological justification for this change. The fact, however, does not affect our analysis, since this structure is already represented at 7.

The introduction of the "Sentence-building" test at 7, and which involves, as we have already seen, the cognition of concrete ideas in relation, is in keeping with the presence of the "Comprehension" and "Similarities" tests now found at this age. As already noted, the difficulty of this test depends upon the intellectual distance of the given words from each other, and the closer these words are to each other, the less does the need for conscious manipulation of them arise. In this each set of three words is simple and suggestive, and the standard of sentence is lenient.

At 8 we find a "Verbal absurdities" test, a type belonging formerly to year 10. This type we have already described as involving the objectification of general rules governing groups of concrete ideas (concrete ideas in relation), and of recognising the incompatibility of the two resulting wholes. In such a test as "I know a road from my house to the city which is downhill all the way to the city and downhill all the way back home", we have two groups of concrete ideas - that of house, city, and a road leading downhill from the first to the second, and that of city, house, and a road leading downhill in the opposite direction. The incompatibility is between these two groups of ideas. Either might be true, but they cannot both be true at the same time.

On the other hand, the statement: "A man had influenza twice. The first time it killed him, but the second time he got well quickly", involves the following ideas: A sick man dying, and later the same man recovering from an illness. These are the incompatible elements. But here we have to do only with two concrete ideas, not two groups of related ideas, as in the former case. We have to do with states or acts of the same subject, not with relations between one subject or object and another. The incompatibility is between two states or acts.

Again, in the test: "Walter now has to write with his left hand because two years ago he lost both his arms in an accident", we have: A person writing with his left hand: A person without any arms. These are once more two concrete ideas, with the incompatibility lying between an act and a state.

Lastly, in the test: "An old gentleman complained that he could no longer walk round the park as he used to; he said he could now go only halfway round and back again", we can have either the idea of two halves being equal to the whole, or, less abstractly, we can form a mental image of the park and compare the two distances. It need thus involve no more than a comparison of concrete ideas, the incompatibility here being one of dimensions and not of states.

Three of these four tests in Form M., therefore, are on a lower level, and involve the recognition of the incompatibility of two concrete ideas, that is, the cognition of concrete ideas in relation.

In Form L., age 8, we have the following:

(a) "They found a young man locked in his room with his hands tied behind him and his feet bound together. They think he locked himself in."

Here we have a variant of the test where an armless man writes. A bound man locks a door, or he ties his own hands.

(b) "A wheel came off Frank's motor car. As he could not get the wheel back on by himself, he drove his motor car to the garage for repairs."

This is another case of two concrete ideas, a car being driven, and a car without a wheel. Incompatibility of act and state.

(c) "I read in the papers that the police fired two shots at a man. The first shot killed him, but the second did not hurt him much."

This is a similar situation to that in which the man died from influenza, but recovered from the second attack. Here a man is killed, and then only slightly wounded. Two concrete ideas. Incompatibility of two states.

(d) "An engine-driver said that the more carriages he had on his train the faster he could go."

Here we have the idea of an engine pulling a train of a certain size and travelling at a certain speed, together with that of a lengthened train travelling at a greater speed. But in this case the incompatible elements consist of complex ideas, for one must think of size of train in relation to speed in both cases. (Of course this test may be vitiated by the child possessing a toy railway. He will then know this fact by experience, without having to think relationally.)

In this set of tests also three out of the four are on the lower level.

As the pass is three correct out of four in each case, it can hardly be said from this evidence that children of 8 are able to cognise complex ideas in relation, which, in the original Terman scale, belongs to year 10.

A verbal absurdities test appears also at year 9 in the new scale. In Form L. we have:

(a) "Bill Jones's feet are so big that he has to pull his trousers on over his head."

This absurdity is based simply on a physical impossibility, and all that is needed is a clear mental picture of the garment concerned, together with that of the shape of the human body. There is no logical contradiction. It involves the incompatibility of two mental images.

(b) "A man called one day at the post-office and asked if there was a letter waiting for him. 'What is your name?' asked the postmaster. 'Why', said the man, 'you will find my name on the envelope.'"

If the name is known, the envelope need not be known. If the envelope is known, the name need not be known. But if anything is to result, they must not be both unknown at once. So we have here two complex ideas, each involving a relation between a knower, an object, and a name.

(c) "The fireman hurried to the burning house, got his fire hose ready, and after smoking a cigar, put out the fire."

The contradiction here is practical, not logical. The fireman first hurried to the fire, then he delayed action when he got there. We have here two concrete ideas - that of the fireman hurrying, and that of the fireman wasting time. Or, the idea of the house rapidly burning, and that of the fireman calmly looking on. Incompatibility of acts.

(d) "In an old graveyard in Spain they have discovered a small skull which they believe to be that of Christopher Columbus when he was about ten years old."

The skull of a ten-year-old boy. The skull of Christopher Columbus. Either might be found, but the two are incompatible. The incompatibility is between the attributes of two concrete ideas.

(e) "One day we saw several icebergs that had been entirely melted by the warmth of the Gulf Stream."

Once more - the incompatibility of states of two concrete ideas. The score is 3 out of 5. Only one (b) is on the level of complex ideas.

In Form M. we have:

(a) "I saw a well-dressed young man who was walking down the street with his hands in his pockets and twirling a brand-new cane."

Here is simply a physical impossibility, involving the incompatibility of the two mental pictures - of state and act.

(b) "A father wrote to his son, 'I enclose ten pounds. If you do not receive this letter, please send me a telegram'".

Knowing to send a telegram depends upon receipt of the letter. The need to send it depends upon not receiving the letter. Hence we have to deal here with two incompatible complex ideas.

(c) "A soldier on the march complained that every man in the regiment was out of step except himself."

This is not exactly a contradiction, but a matter of opposing values. There are two concrete ideas which, however, cannot both be right, and the soldier places correctness-value upon the wrong one. The absurdity lies really in his ego-centrism. Incompatibility of values of two concrete ideas.

(d) "A kind-hearted man who was taking a heavy bag of grain to town on his horse, sat on his horse and lifted the bag to his own shoulder in order to make the load easier for the horse."

This involves two complex ideas - the relation of the weight of the bag to the man, and the relation of the weight of the man plus bag to the horse. The two relations must be seen to bear ultimately on the horse. Here we have an inseparable relationship which the kind-hearted man believed to be separable, and the child has to see the impossibility of the separation of the two sets of ideas.

But a pictorial short-cut can be made to this conclusion by the simple picturing of the man with the bag seated on the horse. The child can then see at once that the horse bears all the weight, without his having to think the matter out. This imagery short-cut is possible in this particular case, because the absurdity lies not in the incompatibility of two falsely united complex ideas, which cannot be pictured together, but in the failure to unite two complex ideas which really belong to one another. Thus the situation can be pictured directly as a whole.

(e) "A man said to his friend: 'I hope you live to eat the chickens that scratch the earth on your grave.'"

Here are two complex ideas - living long enough to eat certain chickens, and the chickens that scratch the earth on his own grave.

In this series we have two (b and e) involving complex ideas, and three at the lower level. The score is 3 out of 5.

Thus, in neither of these two series at age 9 is the child expected to think in terms higher than that of concrete ideas in relation, in order to pass the tests, which is the same level as that found at 8.

It is not surprising to find "Memory drawing" moved from year 10 to year 9, since, as was pointed out in our previous analysis, this test is not qualitatively on the level of the other significant 10-year tests in the 1916 revision. There is nothing in this test which is not found at the 7- or 8-year level in regard to structure, although there is no actual example of such a test. It involves the grasping of wholes in terms of imagery and their relation to one another. The category of whole and part in reference to an object is already in use at 6, and in reference to a concrete idea at 8.

At year 9 (Form M.) a "Dissected sentences" test is placed. Like the new sentence-building test at 7, these sentences are much simpler than those of the former scale; and there is no evidence in Terman's quoted cases of failure that the general meaning of the sentences has ever been misunderstood. For the crux of the matter is, that in solving these little problems, the eye tends to look first for "key" words which may suggest the general meaning or trend of the sentence. If these principal ideas are capable of arrangement in two or more different ways, they may have to be manipulated by the subject into the various possible arrangements until the arrangement is found in which the intermediary words are seen to fit.

This may be evidence for the presence of idea-manipulation in the case of those who pass; and evidence for the need of such manipulation can be seen if some of the failures show an alternative or wrong meaning. If, on the other hand, there is only one possible arrangement of the key words which could make a sentence at all, there can be no question of idea-manipulation, but only of the grasping of a complex idea.

In the sentences given at this age:

"A have dog I fine"
"Wool the was coat of made"
"Child the playing garden in the is"

there can be no doubt that they deal with "I" having a dog, a coat made of wool, and a child playing in a garden; and it is merely a question of being accurate in regard to the placing of the intermediary words and to the grammatical arrangement.

On the other hand, in such a sentence as:

"A defends dog good his bravely master" (age 13, Form L. and M.)

one can have "A good dog defends his master bravely", or "A good master bravely defends his dog" - showing that these key ideas "Defends", "Dog", and "Master" are here capable of manipulation and that the correct meaning is not directly suggested to the child, as in the former case. (See terman (8) p. 277.

In view of the fact that concrete ideas in relation can be objectified at 7, and the function involved in this test is simply to see the dismembered parts of the sentence in relation to one another, there is nothing here qualitatively different from year 7.

In regard to all the above new tests at 9, there is no evidence of any qualitative level, or structure, appearing at this age higher than that already seen at 7 and 8, namely, the cognition of concrete ideas in relation.

The "Comprehension" questions found at 8 in Forms L. and M., are in some respects different from those of the original scale, which are now placed at 7. In two out of each of the three questions the child is asked either to place himself in an unusual situation and state his reactions, or state how a man should act in such and such a situation. These questions are of a purely practical kind, such as:

"What should you say when you are in a strange town and someone asks you the way?"

and "What should a man do if he comes home and finds that a burglar has robbed his house?"

The remaining tests (one in each scale) are concerned with mechanical matters:

"What makes a sailing-boat move?"

and "Why is a train harder to stop than a motor-car?"

In the first type of test the child has to imagine an unusual situation and view it objectively, In the second type he must have some expected of the child at 8 or 9.

This higher level at 10 is also demanded by the "Absurdities" test in the 1916 scale. We have already seen that the question "I know a road from my house to the city . . . . " and "An engine-driver said that the more carriages he had on his train . . . . " are of this kind. The same applies to the question regarding the body of the girl found cut into eighteen pieces, and who was believed to have killed herself. Here we have a complex idea - a body cut into eighteen pieces - related to an incompatible complex idea - a girl who had killed herself. It is to be noted that the latter is not equivalent to the concrete idea "a dead girl". It involves the relationship between the girl and the various possible methods of killing herself, which is then seen to be incompatible with the body in eighteen pieces.

In regard to the "Railway accident" absurdity, we have the incompatible relation between the complex idea of a slight accident with its implied lack of injury to passengers, and that of a large number of people killed with the implied seriousness of the accident.

In the last question of the series, - that of the cyclist who was killed and then taken to hospital, - we have the concrete idea of a dead person on the one hand, and that of a person seriously injured but not dead. In spite of the apparent complexity of this test, it is similar to that of the man who took influenza twice, and to that of the man whom the police shot at twice, and involves simply two concrete ideas.

Thus four out of the five questions at year 10 in the 1916 scale involve complex ideas; and the score is 4 out of 5. The two scales are therefore in agreement that this level of thinking, and the mental structure which it involves, belongs to year 10.

A change in the new scale at 10, however, is the introduction of an "Abstract definition" test, formerly placed at year 12. In the 1916 scale the words are: "Pity", "Revenge", "Charity", "Envy", "Justice". Here (Form M.) they are "Pity", "Curiosity", "Grief", "Surprise".

It may safely be said that the younger child's outlook on the world is affective before it is intellectual, and therefore it is natural to expect that a term which describes a feeling is more likely to be grasped earlier than a purely intellectual concept. It will be noted that all four words at age 10 are the names of feelings; but of the five words formerly given at 12, only two represent feelings, namely, Pity and Envy. Charity and Revenge may be the outcome of feelings, but are not themselves feelings; while Justice, of course, is a purely intellectual concept. It is noteworthy that in the new scales Revenge does not appear until year 11 (L. and M.), Charity not until 12 (L.), and Justice not until 14 (M.). On the evidence before us, therefore, we may conclude that the intellectual-abstract type of concept is not cognisable by the child until 11 or 12 years, although some of an affective significance are cognisable at 10. The score at 10, however, is only 2 out of 4 - too low a percentage to be significant.

At year 11 of the new scale (Form L.) we have another series of verbal absurdities, abstract words, a test for "similarities" (three things) which was formerly at 12, besides two memory tests and a word-naming test which are non-significant for this age. The "Absurdities" test is as follows:

(a) "A judge said to the prisoner 'You are to be hanged, and I hope it will be a warning to you.'"

Here the child must cognise the word "warning" as implying a future for the person addressed, which involves a complex idea (What happens to you now should have a bearing upon your future conduct"). This must be brought into relation with the incompatible complex idea of the man who is to be hanged and have therefore no future.

(b) "A well-known railway had its last accident five years ago and since that time only one person has been killed on it in an accident."

Here the child has to deal with two complex ideas - an accident, five years ago, which was the last; and a person killed in an accident since that time.

(c) "When there is an accident the last carriage in the train is usually damaged most. So they have decided that it will be best if the last carriage is always taken off before the train starts."

Once more we have two complex ideas - the last carriage which is usually damaged most; and the solution of the difficulty by removing the last carriage. The relation here, however, is not one of incompatibility, but of logical non-coherence.

The score for this test is 2 out of 3; and we have here the higher level of thinking, as at 10.

In Form M. at 11, however, there are repeated the same absurdities as at year 9, with the difference only of a higher score - 4 out of 5. As in that series two of the five questions were of the higher level, at least one of these must now be answered correctly in order to pass at this age.

The abstract words given for definition at 11 (L. and M.) are:

"Connection", "Compare", "Conquer", "Obedience", "Revenge", the score being 3 out of 5. In these five words nothing of the feeling element is represented. The score, however, is still low.

The "Similarities" test "L. and M.) is a continuation of that now found at 7, and has therefore no special significance at this age.

At year 12 the "Ball and field" and "Dissected sentences" tests are omitted in the new scales and promoted to year 13; but abstract definitions appear once more in both scales, besides "Memory for designs" at a more difficult stage (M), "Five digits reversed" (L. and M.) as before, and a verbal absurdities test (L).

The abstract words in Form L. are: "Constant", "Courage", "Charity", "Defend", the score being 2 out of 4; while in Form M. they are the same as at year 10 (Pity, Curiosity, Grief, Surprise), with a score of 3 out of 4. The latter is the first occasion in any of the three scales in which we are given a significantly high score in abstract definitions. Hitherto, 3 out of 5 has been the highest we have met. These words, however, are all of the affective type of concept. The series of non-affective terms used at 11 (Form M.) are not passed with a significantly high score until year 13 (M) where the score is 4 out of 5.

It would seem, therefore, that the objectification of purely abstract (intellectual) ideas is barely normal at year 12. When the terms are non-affective, a score of only 2 out of 4 is required; and a significantly high score is achieved only through using terms of an affective kind. This would seem to be borne out by the 1916 scale, where, of the five words used, two are of the affective type with a 3 out of 5 score.

The verbal absurdities test at 12 is a repetition of that at year

9, with a score of 4 out of 5. It has therefore no significance here.

There is no level of thinking shown in these 12-year tests higher than that seen at year 11, except possibly in regard to the objectification of abstract ideas. But since the terms used at 11 are of the intellectual type in both scales, we cannot tell how the child of this age would respond to the affective type of concept. Certainly, as far as the intellectual type is concerned, there would appear to be no difference between the two years; for the score demanded at 11 is 3 out of 5, and that at 12 is 2 out of 4.

Before drawing up a modified form of Table 1, in the light of these new findings, we must now examine the remaining tests, which are different in type from those used in the original Stanford Revision of the scale.

At 5 (Form L.) we have "Picture completion" (Man) and "Paper-folding" (Triangle); and (Form M.) "Picture vocabulary" and "Pictorial similarities and differences".

The first is a form of "missing feature" test in which one missing feature (the leg) is pointed out to the child and which he has to fill in as well as to discover and fill in a second missing feature (arm, mouth, or nose). This represents a 1 out of 3 score, or, if we count the leg, 2 out of 4; and, as in the case of the other test of this kind, where the score is only 3 out of 5 at this age, this serves to show that full cognition of objects is not yet present at 5.

The paper-folding test is largely a matter of imitation, and is therefore not significant at this age. Likewise the "picture vocabulary" test is not significant, being concerned merely with the naming of objects, already present in the former scale at age 3. "Pictorial similarities and differences" involves the cognition of aspects of objects at the perceptual level, and which belongs to this age also in the old scale.

At 6 the new tests are "Copying a bead chain from memory" (L. and M.) "Maze tracing" (L.), and "Opposite analogies) (M).

The first is a simple memory test, there being no "whole and part" element in the pattern, as in "memory drawing", and is therefore not significant at this age. The "Maze tracing test" involves the grasping of the situation as a whole and of seeing how the starting-point is related to the goal in respect of distance. It requires the use of the category of whole and part in reference to a perceived object, and is a factor which we have already seen to be present at this age.

The "Opposite analogies" test involves a relationship - of opposition on the one hand, and of either class-inclusion or attribution on the other. But these relationships are not brought to conscious expression. Conscious class-inclusion or attribution (definition superior to use) appears only at a later age. Here it is brought about by means of suggestion, i.e. by means of the preceding statement. The definition, in other words, is "suggested out" of the child. The same applies to the relation of opposition. The child is not asked "What is the opposite of . . .?" The relation is suggested, not demanded. We cannot say, therefore, that we have as yet any evidence for relational thinking in terms of concrete ideas. This, apparently, still lies below the surface of conscious thought, and at this age has to be "dug out" of the child by means of suggestion.

At 7 we have a new type of test in the form of "Picture absurdities"

(L. and M.). Here the situations do not need to be mentally pictured, i.e. the ideas do not need to be objectified, but only used. All the ideas involved are concrete, and we have therefore cognition of the incompatibility of the acts or states of depicted objects in the light of non-objectified concrete ideas in relation. This represents a lower mental structure than the new 7-year level of objectified related ideas.

"Counting taps" (Form M.) consists in the child counting tapping sounds (score 3 out of 3). There appears to be nothing in this test other than the factor of attention, and it is therefore not significant.

A further "opposite analogies" test appears here (Form L.) with a higher level of scoring. This, of course, has no significance.

At 8 (Form L.) there is a new form of "Reading for memories" test, a "Similarities"and difference" test, and a "Problem situations" test (Form M.). The first, of course, is not significant at this age, the second is a combination of the tests already found at 6 and 7 separately, and is therefore non-significant.

The third, - "Problem situations" - involves two or three concrete ideas being presented together in a situation and the child being asked to discover the relationship between them. This involves the grasping of concrete ideas in relation, the missing relation being supplied out of experience of similar observed situations. This structure belongs to year 7 in the new scales, and this test is therefore not significant. A further "opposite analogies" test is also given at this age.

At 9 (Form L.) there is a "Paper-cutting" test. This involves the manipulation of imagery, for the paper must be unfolded in imagination by the child. He must picture a process. This is the first evidence we have found of this particular function - as distinct from mere imagery-control; and as this function is closely akin to the manipulation of concrete ideas, this seems to confirm our placing the latter at year 10.

The new form of Rhyme test given at this age (L.) involves the search for a rhyming word within a given class of words - a colour, a number, an animal, and a flower. This was also a 9-year test in the original scale, and the modification now introduced does not alter the quality of the test. In Form M. there is a "Similarities and differences" test with a higher level of scoring than at 8 (L).

At 10 (Form L.) - apart from a further "Picture absurdities" test which is not significant for this year, - the only new type of test is one of "Finding reasons". Nearly all the "minus" answers quoted by Terman for this test show that failure was due to giving only one reason instead of the required two, and not to a failure in reasoning. The point here is, that, in most cases in practical life the giving of more than one reason is superfluous, and to be asked to give two specific reasons for the same thing involves the child thinking of reasons as such. He must consider his reasons objectively, giving one and then deliberately seeking another to place beside it, avoiding at the same time the tendency to become "lost in his own description", as Terman expresses it. This test, then, involves the deliberate placing of one group of related concrete ideas beside another given group, in the particular relation demanded by the question. This is the objectification of complex ideas in relation, which, as we have seen, is characteristic of year 10.

In Form M., at 10, we have a new test - "Block counting" - in which the child must calculate the number in a series of piles of cubes depicted on a card, taking into account those cubes which are not seen. As the child is previously given three trials, and the method of counting is explained to him if he fails in any of these, the test would appear to be nothing more than a matter of arithmetic and involves no structure that is not already present at this age.

At year 11 (Form L.) there is no new type of test, and in Form M. there are continuations of two already dealt with. These are a "Finding reasons" test, and "Copying a bead chain from memory". The latter now involves a pattern, and therefore the same factors are involved as in the case of "Memory drawing" - cognition of whole and part in terms of imagery - already found at year 9.

At 12 (Forms L. and M.) the only new test is the "Minkus Completion" test. Here we have very clearly an example of complex ideas in relation, and since the actual relating concept is omitted and has to be supplied by the child, we have for the first time the objectification of a relational concept. This cognition of a pure concept of relation is to be expected with the appearance of the cognition of certain abstract ideas at 11 and 12; but as the score is only 2 out of 4 we have some confirmation of our assumption that objectification of the purely abstract is only beginning at this age.

A marked characteristic of these new scales is the appearance at lower year-levels of certain significant types of test which, by being watered down, have been made suitable for these earlier years. The appearance of such simplified forms of these tests is the sort of thing which is used as a basis of argument by those who prefer to think that all mental development is smooth, and that there are no marked periods of change. But by watering down a test in this way (either by simplifying it or by reducing the standard of scoring) we show nothing but the fact that the test can be performed earlier if we water it down. For if we simplify the test beyond a certain point, we alter its significance, and it drops to a lower structural level; and if we reduce the scoring standard to 50% or 60% we merely show very clearly that the child cannot yet normally perform the act. In the latter case, we show the beginnings of the change; but a change is none the less a change because it has a beginning. What is important from the educational point of view, however, is to know when it is completed.

We are now in a position to draw up a modified form of Table 1, showing the mental structure of the child at each of these ages in the light of the new scales (Table 2). Unfortunately, the "Fable interpretation" test is not included in either of the new scales, "Proverb" tests with a higher score taking its place at the "average adult" level. The ability to objectify ethical rules, therefore, like cognition of purely abstract ideas, must be assumed to be only beginning at 12, in view of the lack of any evidence to the contrary.

Table 2 is based on Table 1, changes being made only in so far as the new scales contradict the old, and in the introduction of the 11-year level.

TABLE 2.

COGNITION

5	6	7	8	9	10	11	12
Aspects of Objects	Objects distinct from a Context	Concrete Ideas			Complex Ideas in Relation		Abstract (affective) Ideas
Imagery of a Total Situation	Aspects of Concrete Ideas	Concrete Ideas in Relation			General Ideas or Factual Rules		Ethical Rules ?
	"Right and Left"	Single mental Images					
(Partial) Objects distinct from a Context					(Partial) Abstract (affective) Ideas	(Partial) Abstract Ideas	(Partial) Abstract Ideas and Relational Concepts
USE							
Concepts of Quality in reference to Objects	Free Concrete Ideas	Abstract Ideas as Concepts of Relation					
	Concepts of Quality in reference to Concrete Ideas	General Ideas or Rules					
	Number in reference to Objects						
	Category of Whole and Part	Category of Whole and Part			Category of Whole and Part		

TABLE 2

(Continued)

5	6	7	8	9	10	11	12
USE							
	in reference to an Object	in reference to a Concrete Idea			in reference to Complex Ideas		
FUNCTION							
Control of Total Imagery		Control of Free Images and Free Concrete Ideas		Manipulation of Imagery	Manipulation of Concrete Ideas ?		

The fore-going table shows a certain regularity in development. There appear go be three phases: (1) From 5 to 7, during which control over imagery and the objectification of concrete ideas is developed. (2) From 7 to 9, during which the objectification of concrete ideas in relation develops. (3) From 10 to 12, during which complex ideas in relation are objectified, together with general ideas or rules, and the beginning of the objectification of abstract ideas makes an appearance.

During this development there can also be seen a progress from the "use" to the objectification of the various grades of ideas. Elements appearing at the sub-cognitive level ("use") during one phase, tend to appear on the cognitive level during the next. Thus, concrete ideas which the child has used during his early years in naming and recognising objects, become free and objectified only during the 5 - 7 period. General ideas, used at 7, become objectified at 10; and abstract ideas used at 7 do not begin to be objectified until 11 or 12.

The "use" of ideas has, of course, various levels, depending upon the manner in which the ideas are expressed and the sphere in which they are applied. For example, the concept of "Justice" is implied in the behaviour of the youngest child who weeps because he feels he has been treated unfairly, although he may not be old enough to express the fact in the simplest terms. Here the concept is probably quite below consciousness. Later, when he learns to use the word "fair", the idea lies less deeply below the surface, but it is not yet objectively cognised. The new scale does not expect him to do this with any degree of certainty until he is an adult.

We are not concerned here, however, with the beginnings of the use of ideas, but with the sphere of their use and the period of their objectification during the elementary school years. And while it may be said with truth that children possess these ideas and act upon them from the earliest years, that is nothing to the point. The point is not what they possess, but what they are able to do with what they possess.

There is also a certain orderliness of progress in respect of the functional aspect of development. Objectification of "total" imagery appears at 5, control of free images at 7, and manipulation of imagery at 9. Similarly, objectification of free concrete ideas appears at 7 with manipulation at 10. Manipulation seems always to lag behind the other processes, so that objectification of concrete ideas in relation (period 7 - 9) lies within the period in which manipulation of imagery appears (at 9); objectification of complex ideas in relation at 10 is accompanied by manipulation of concrete ideas; while manipulation of abstract ideas is not shown in the tests until the level of "Superior Adult 1", where there is a test for sentence-building out of abstract ideas.

We are now in the position to give an exact definition of the term "thinking" as it will be understood in our further discussion. For our present purpose, since this inquiry has to do with the teaching of school subjects, genuine thinking may be said to begin when the process is under the control of the ego of the child, i.e. when that which is thought about can be apprehended objectively by him, whether it be an object, an image, or an idea. The child can cognise individual objects at 6 and free images and concrete ideas at 7. An object can be thought about only when it can be apprehended as such, i.e. in abstraction from the total environment, for only then can one see it in relation to the rest of the environment, or its own parts in relation to itself as a whole.

Anything seen only as belonging to a general context cannot be thought about; it can only be observed. The same applies to imagery.

Previous to that point a child may have thoughts, and he may express them. He may give vent to quite wise remarks or ask apparently profound questions. But to have thoughts is not the same as to think. To think is a deliberate act, the selection at will of an object, image, or idea with a view to discovering its relations with other of its kind. This is possible only when an object can be cognised as such, or when images and ideas can be brought under control. The wise sayings or deep questions which arise spontaneously in the young child are of little avail when he is faced with a task in arithmetic. Here, even at its simplest, it is necessary for the child to call up a free image, relate it to another free image, and discover the result. Thus the type of thinking which will be required of him in much of his school work can be said to begin only when this mental structure is found. All forms of thinking found previous to this must be placed in a different category.

In so far, then, as thinking involves some purely "mental" activity, dissociated from physical objects, this can be said to be found first at the 7-year stage, when not only free images and ideas can be brought under control but when concrete ideas can be apprehended together in relation.

Any attempt to deduce from the apparent epistemic nature of children's questions (as in the Appendix, by Nathan Isaacs, to "Intellectual Growth in Young Children") that the structures of the child and the adult mind are alike, fails to take account of the relationship in which the questioner stands to his thoughts. The fact that such questions are alike in form in the case of both adult and child tells us only that both adult and child possess ideas of the environment, and that they are both disturbed when the environment does not correspond to these preconceived ideas. But that does not constitute identity of structure in the sense in which we have used the term. That young children possess ideas of the environment, is obvious, and that they should feel disturbed when the two do not correspond, is natural. But ideas and feelings are part of the <u>contents</u> of the mind; structure has to do with its <u>form</u>. It depends upon the relationship existing between the individual and his ideas. Can he objectify them, or not? Can he control them, abstract from them, manipulate them? Not one of these mental acts is necessary in order to see that the environment is not behaving as we expected. The fact, therefore, that both adult and child ask epistemic questions about the environment, is not only no proof that their mental structures are alike; it does not even begin to indicate what these structures are.

We have now some indication of the general tendencies of development in the child mind, as shown by these scales, and some idea of the mental structure at each age. The difference between the child and the adult apparently is, that while the adult can adopt, at will, any relation to his ideas, the child's mental structure is limited by his age. This, of course, has reference to the average child, and we omit in the meantime the question of mental backwardness or precocity; for this aspect of the matter can be satisfactorily dealt with only when we have considered to which factor backwardness or precocity is due, - that is, whether to mental structure or to the development of the ego, or both.

In the meantime it can be seen that there is little room for the assumption, made by Mrs. Isaacs, that scientific and imaginative interests develop side by side in the child. Objectification of imagery precedes even the most concrete relational thinking by two years; while the necessary mental structure for any thinking which could be termed "scientific", relating to wholes of concrete ideas, is not found until 10.

Development, apparently, has two aspects. There is the structural development, which appears to take place at intervals and more or less abruptly; and there is the ego-development which appears to be continually in progress in the shape of the more skilful use of those structures which have already appeared. This is seen, for example, in the gradually increasing control over imagery throughout the years 7 to 12, or in the ability to perform, with a higher score, any test previously introduced. This aspect of development, in fact, is seen in the presence of all non-significant tests, where the difference from similar tests in earlier years is merely one of degree of difficulty, and not of mental structure. These two factors in development appear, therefore, to be in some respects independent of one another.

It can already be seen at this stage that mental development - even average mental development - cannot be expressed in terms of some simple or regular curve. For we are dealing here not with an abstraction, such as the Intelligence Quotient, but with the actual year to year mental changes in the growth of the average child.

We shall now examine the problem from another angle.

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PART 3.

DEVELOPMENTAL CURVES.

Having made a qualitative analysis of the child's intellectual development, as expressed by the Terman-Binet scales, the question now arises: How does the matter stand from the quantitative point of view? Does a quantitative analysis of test data show any evidence for these changes in structure? For it is clear that, with the appearance of a new structure at a given age, the ability to perform certain tests should show a sudden improvement; while, after the change has been established, one would expect a gradual decline in the rate of progress.

In the following investigation data only from Binet tests will be used, since these have been universally standardised and correspond to the tests we have been considering. The method employed is as follows:

The percentages of passes, as found by any given investigator for the separate tests at each chronological age, are first translated into terms of the standard deviation of the normal curve of distribution. The difference between any two such figures representing consecutive chronological ages will therefore represent the progress made in develepment between these two ages, as far as any given test is concerned.

Thus if we take for example the percentages for the test of counting from 20 to 0, quoted by Burt (6), we arrive at the following figures:

Age:	6		7		8		9		10		11
%	28.0		73.6		76,0		86.1		96.0		98.3
S.D.	- .58		+ .09		+ .71		+ 1.09		+ 1.76		+ 2.12
Differences:		.67		.62		.38		.67		.36	

These standard deviation "intervals" can now be considered along with those of other tests covering the same ages, and an average S. D. interval for any given year- interval can be arrived at, and which will indicate the rate of development during that year. This can then be compared with similar results derived from the data of other investigators.

In order to make such an average S. D. interval comparable with that derived from the data of any other investigator, the average yearly S. D. interval for all the age intervals - i.e. the complete age series - is found, and each particular year-interval is expressed in terms of this general average interval. In this way the average rate of progress between one given age and the next is expressed as a ratio of the average annual rate of progress throughout the whole age-series; and geographical or racial differences between the groups of children are thus eliminated. For it is then not the actual rate of progress in a given year, say, of London children, which is being compared with that of a group of children in Germany, but the relative rate.

To take a concrete example, the average S. D. interval for certain tests in Burt's data for the age-interval 6 - 7 is .68, while that of Bobertag's data for the same type of tests is .87; but the average S.D. interval for all such tests over the years 5 - 12 in Burt's data is .53, while that of Bobertag is .68, and the resulting ratio (.68 : .53 and .87 : .68) is in both cases 1.28.

Since, in this way, the ratio for any one year-interval will be 1 when the average S. D. interval for that particular year coincides with the average interval for the whole age-series, these figures can conveniently be expressed in terms of their difference from that average, or from unity. Thus, 1.33 can be expressed as +.33, while a ratio of .80 would be -.20. The amount and direction of developmental fluctuation can then be seen at a glance. Such ratios we shall term "Progress Ratios".

It is not possible, however, to slump together in this way all the tests to be found at any one age, if we wish to arrive at an accurate estimate of the rate of development from year to year. For one type of mental process (representing some given structure) may be just reaching the highest point of its development in the same year in which another type is only beginning to develop. For example, control of imagery has been seen to reach a certain completion at 7, while at that age relational thinking is only beginning. Obviously, to mix the results of tests involving such different mental functions would be only to blur the issue.

Our analysis of the Terman scales has shown three lines of structural development, - that of cognition of objects, arising at 6, that of the objectification and control of imagery and concrete ideas, culminating at 7, and that of relational thinking, beginning at that year. The tests now to be analysed quantitatively are divided therefore into three groups: (1) Tests involving simple (non-relational) mental processes connected with something immediately present in the physical environment (such as Divided Card, Diamond, Right and Left Hand, Counting 13 Pennies, Missing Features, Pence and Halfpence, Coins, Picture Description, etc.). (2) Tests involving simple mental processes not connected with the immediately present physical environment (such as Repeating 5 Digits, Concrete Differences, Days of Week, Months, 16 Syllables, Morning and Afternoon, Counting 20 to 0, Reading for Memory, Definition, etc.). (3) Tests involving thinking of a relational kind, whether connected with the immediately present environment or not (such as Arranging 5 Weights, Date, Giving Change, Comprehension (3 and 4), Similarities, Sentence-Building, Picture Interpretation, Memory Drawing, Mixed Sentences, Absurdities, etc.).

In regard to group 2 it should be explained that even although in some cases - such as in 5 Digits, 16 Syllables, and Reading for Memory,- the digits, syllables, and reading-matter are actually presented to the child there and then and thus form part of his environment for the moment, the fact remains that they are not present when he gives his answer, which has to be based on a purely mental process, namely, that of memory and its control. The child has nothing in his immediate environment to lean upon. That is the criterion used here.

In addition to dividing the tests into these three types, certain statistical precautions have been taken.

(1) In order to ensure that the tests in any one year-interval are reasonably suited to these ages, being neither excessively easy nor impossibly difficult, intervals which lie wholly below 25% or wholly above 74% have been ignored.

(2) In order to eliminate chance factors among those which remain, all S. D. intervals in any one year-group which exceed by more than two-thirds, or are more than two-thirds below, the average interval for that group, are discarded, (i.e. intervals more than 5/3 or less than 1/3 of the average). We are thus left with a group of figures for each year-interval, which, in a normal curve of distribution, would represent a range of approximately -1 to +1 S. D.

(3) With the comparatively small numbers of children with which we have to deal, it would be unjustifiable to credit percentage intervals reaching into the "nineties", or originating in a very low percentage, with all the significance given to them by the Probability Integral table. Burt (6) (p. 138) in determining the intervals of difficulty between one Binet test and another, translates the percentage intervals into terms of S. D., but disregards percentages above 90 and below 10 on account of the large influence exerted by a small error in these very high or low percentages. Rather, however, than make such an arbitrary barrier, a modified solution of this difficulty has been adopted.

All intervals between -1 and +1 S. D. - that is, intervals between 15.9% and 84.1% - have been treated as "significant", and a distinction is made between such intervals and those which extend beyond these boundaries. Since, for our purpose, the nearer a percentage beyond these figures approaches 0 or 100, the less do we wish to treat seriously the rapidly increasing deviation, the value for us of an interval which extends beyond 15.9% or 84.1% is in proportion to that part of the total interval which lies within the two boundaries.

For example, an interval which extends from 65% to 95% (difference, 1.26 S. D.) is regarded as fully significant from 65% to 84.1% - an interval of .61 S. D.; but the remainder of the total interval, from 84.1% to 95%, is less significant. The latter portion, representing .65 S.D., is therefore modified by multiplying it by the ratio of the former, or significant, part to the whole.

Thus:	Total interval	1.26 S.D.
	Portion above 84.1%	.65 S.D.
	Portion below 84.1%	.61 S.D.
	Ratio of lower portion to whole .	.48
	Upper interval modified by this ratio (.65 X .48)	.31

Thus the upper portion of the interval is reduced to .31, which, added to the lower portion (.61) makes a total interval of .92.

The justice of such a method of modification can be seen from the following examples. If an increase of, say, 26% in the number of passes in a test is found between one age and the next, the figures being 74% in the one year and 100% in the next, while another test shows an increase of the same amount, - from 70% to 96%, we can hardly claim that from a psychological point of view there is any very significant difference between these two intervals. Yet, in terms of S.D. the first interval is 2.35 (taking 100% as equal to 3.00 S.D.), while the second is 1.23, suggesting that the first is nearly double the value of the second. Calculated by the method here employed, however, the first is .66 and the second is .77. The fact that, in this case, the first turns out to be slightly less than the second, is due to the progressive lessening of the value of the higher percentages, so that here the difference between 96% and 100% becomes automatically ignored. In this way exaggeration of an interval is avoided, without at the same time ignoring altogether the meaning of high or low percentages, when these form part of a significant interval.

(4) The more purely scholastic tests, such as Dictation and Transcription, are omitted, as also are the Ball and Field, and Bow-knot tests, which are neither universally used nor similar to any of the other Binet tests. Likewise the Healy-Fernald Form-board test is omitted, and the Vocabulary tests are discarded for the reasons previously given.

The sources of our data must necessarily be confined to records of the actual numbers or percentages of passes for each individual test over a range of consecutive ages, and the following have been found by the writer to be available:-

x Decroly et Degand: Archives de Psychologie: 1910. (9)
Alfred Binet: L'Année Psychologique: 1910. (10)
x Alice Descoudres: Archives de Psychologie: 1911. (11)
Otto Bobertag: Zeitschrift für angewandte Psychologie: 1911. (7)
H. H. Goddard: Pedagogical Seminary: 1911 (13)
F. Chotzen: Zeitschrift für angewandte Psychologie: 1912. (14)
Terman and Childs: Journal of Educational Psychology: 1912. (15)
Terman, Trost, & Waddle: "Stanford Revision of B.-S Scale" 1912. (16)
x Bloch und Lippa: Zeitschrift für angewandte Psychologie: 1913. (17)
Mary L. Dougherty: Journal of Educational Psychology: 1913. (18)
E. C. Rowe: Pedagogical Seminary: 1914. (19)
x Clara Schmitt: Psychological Review: 1915. (20)
x Alice Descoudres: Archives de Psychologie: 1915. (21)
x Nina G. Taylor: Journal of Experimental Pedagogy: 1916. (22)
Terman, Lyman, Ordahl: "Stanford Revision of B.-S. Scale": 1916.(16)
Cyril Burt: "Mental and Scholastic Tests": 1921. (6)

Some of the above series of figures, however, represent very few children, and those which represent less than 20 children for each age (marked x) have not been used. Binet, however, gives two tables of figures, one being an investigation by Lévistre and Morlé; and Burt gives us not only percentages for normal children but also for children from special (M.D.) schools. The Lévistre and Morlé series has only 10 children at age 7, while that of Terman, Trost and Waddle has only 10 at age 5. These, however, have been retained, as the remainder in both series represents throughout more than 20 children for each age. The results at these particular ages in these two tables may be treated with reserve.

Goddard, on the other hand, although dealing with over 1500 children, gives figures of passes and failures only for those "at age", and consequently some of these tests represent fewer than 20 children. As, however, all these children are considered to be "at age", it is possible to place more reliance upon the results of smaller numbers in this case, and a few of these instances have been admitted into our calculations. None below 15 in number, however, have been considered.

In the case of F. Chotzen, while the numbers are adequate, there is nevertheless a fluctuation in the percentages from age to age in many of the tests - the percentage of passes sometimes decreasing instead of increasing with age. It has therefore not been possible to utilise this series.

The ages quoted by the authors are numerically the mean age, age 8, for example, including children from $7\frac{1}{2}$ to $8\frac{1}{2}$, with the exception of Burt's figures where "age 8" represents a range of 8 to 8;11, or mean $8\frac{1}{2}$.

We are thus left with 11 series of percentages, comprising 10 of the performance of normal children, and 1 of mentally defective children, and representing children in England, France, Germany and America.

In this part of our inquiry we are making no attempt to differentiate between "significant" and "non-significant" tests in the qualitative sense already indicated. What we are seeking here is a series of year-intervals with a view to ascertaining whether or not the qualitative changes already noted have a quantitative effect; and, as a test which is significant for one year becomes on that account non-significant for the next, it is obviously impossible to introduce these distinctions here. Since, however, any qualitative change brings with it new powers to the child, it is to be expected that this will show itself in an improved performance of the non-significant tests also, provided that the tests concerned all represent the same type of mental process.

For example, although the ability to cognise complex ideas in relation is not necessary for passing such tests as "sentence building" or "giving date", the increased ability to handle relations, brought by this new structure, should render the performance of these other tests much more easy, giving greater ability in this respect to those children who have hitherto failed in the simpler forms of relational test. The same applies to the acquisition of control of imagery, in regard to tests involving simple memory and the like.

We shall consider first of all the development of relational thinking. Table 3 shows Burt's data for normal children, treated in the manner described, and involving those tests which require some form of relational thinking. Burt's actual percentages are given, with the S.D. interval (modified when necessary) shown between. Tables 4, 5, 6, and 7 give similar figures for Bobertag, Goddard, Rowe, and Dougherty.

T A B L E 3.

B U R T

(2,674 London School Children)

RELATIONAL THINKING

Age:	5		6		7		8		9
Comprehension (3)	9.6	.70	31.2	.53	51.7	.68	76.5	--	89.3
Giving Date	1.3	--	9.6	.89	36.4	.92	71.4	.42	83.9
Giving Change	0.0	--	10.9	.89	39.1	.75	68.2	.35	79.3
Five Weights	2.6	--	14.3	--	21.0	.45	36.1	.45	53.5
Sentence-build. (2)	0.0	--	5.3	--	14.7	.65	34.4	.31	46.3
Memory Drawing	0.0	--	2.4	--	9.8	.61	28.9	.45	45.7
Comprehension (4)	0.0	--	1.9	--	6.3	--	13.1	.51	28.2
Absurdities	0.0	--	0.6	--	5.2	--	24.4	.14	29.3
Sentence-build. (1)	0.0	--	0.6	--	3.1	--	16.5	--	20.4
Picture Interp.	1.3	--	2.5	--	4.6	--	11.2	--	16.6
Mixed Sentences	0.0	--	0.0	--	0.9	--	15.3	--	21.4
Problems	0.0	--	0.6	--	0.9	--	2.2	--	6.7
Abstract Defin.	0.0	--	0.0	--	0.0	--	1.1	--	2.6
Average Interval:		.70		.77		.676		.375	
Progress Ratio:		+.40		+.54		+.35		-.25	

Age:	9		10		11		12
Comprehension (3)	89.3	--	95.4	--	99.3	--	100
Giving Date	83.9	--	93.5	--	97.6	--	99.2
Giving Change	79.3	--	95.4	--	97.3	--	98.4
Five Weights	53.5	.49	71.9	.31	81.4	--	87.4
Sentence-build. (2)	46.3	.60	69.3	.50	84.3	--	91.3
Memory Drawing	45.7	.42	62.0	.43	76.9	--	81.1
Comprehension (4)	28.2	.54	48.6	.41	64.6	.35	76.5
Absurdities	29.3	.53	49.2	.55	70.3	.28	79.2
Sentence-build. (1)	20.4	.65	43.0	.39	58.1	.28	68.7
Picture Interp.	16.6	.63	36.7	.28	47.5	.63	71.7
Mixed Sentences	21.4	.54	40.1	.38	55.1	.38	69.5
Problems	6.7	--	19.6	.28	28.0	.40	42.8
Abstract Defin.	2.6	--	8.7	--	19.6	.35	30.5
Average Interval:		.55		.39		.38	
Progress Ratio:		+.10		-.22		-.24	

TABLE 4

BOBERTAG

(300 Volkschulkinder (6-12), 35 Spielschulkinder (5-6), 20 Hochschulkinder (6-12), 80 Hilfschulkinder (8-15).) x

RELATIONAL THINKING

Age:	5		6		7		8		9
Comprehension (3)					30	1.08	71	.30	80
Giving Date						--	47	.41	63
Giving Change						--	61	.36	74
Five Weights						--	34	.66	60
Sentence-build. (2)						--	--	--	32
Average Interval:						1.08		.43	
Progress Ratio:						+ .93		-.23	

Age:	9		10		11		12
Five Weights	60	.52	78				
Sentence-build. (2)	32	1.15	75				
Comprehension (4)		--	42	.56	64	.41	78
Sentence-build. (1)		--	39	.36	53	.23	62
Abstract Defin.		--	31	.65	56	.53	75
Absurdities		--	--	--	59	.54	78
Mixed Sentences		--	--	--	56	.62	78
Average Interval:		.835		.52		.466	
Progress Ratio:		+.49		-.07		-.17	

x There were, in addition, some 400 "Volkschulkinder" age 6 to 9 upon whom a few of the tests belonging to these years were tried.
The percentages used are those given by the author.

TABLE 5.

GODDARD

("at age" subjects out of 1,547 children, New Jersey, U.S.A.)

RELATIONAL THINKING.

Age:	5		6		7		8		9
Giving Date					4.8	1.68	59.7	.87	87.2
Giving Change						--	22.4	.99	58.9
Five Weights						--	40.0	1.09	80.0
Definition (genus)						--	41.3	.54	62.5
Average Interval:						1.68		.87	
Progress Ratio:						+ .58		-.18	

Age:	9		10		11		12
Sentence-build.(2)	28.9	1.56	84.4	--	86.6		
Comprehension (3)	61.7	.97	92.4				
Absurdities	41.1	.65	66.3	.83	92.3		
Sentence-build.(1)		--	44.5	.77	72.6		
Mixed Sentences		--	24.3	1.52	79.5		
Abstract Defin.		--	21.9	1.30	69.8		
Average Interval:		1.06		1.105			
Progress Ratio:		.00		+ .20			

NOTE:- Owing to the small number of children shown in the relational tests at age 12, there are no data available for the 11-12 interval.

TABLE 6.

ROWE

(312 Children, Michigan, U.S.A.)

RELATIONAL THINKING

Age:	5		6		7		8		9
Giving Change	24	.66	48	.93	81	--	82	--	82
Giving Date					36	.51	56	(.10)	60
Five Weights					30	.65	55	.23	64
Memory Drawing					40	.50	60	.59	80
Comprehension (4)					17	.34	27	.46	44
Sentence-build. (2)					8	.51	25	.36	38
Absurdities					10	.55	27	.58	49
Sentence-build. (1)					5	--	20	(.76)	47
Mixed Sentences					25	.34	37	.48	56
Average Interval:		.66		.93		.485		.45	
Progress Ratio:		+.30		+.82		-.05		-.12	

Age:	9		10		11
Giving Change	82	--	97	--	86
Giving Date	60	1.07	94	--	90
Five Weights	64	.94	94	--	90
Memory Drawing	80	--	100	--	100
Comprehension (4)	44	.43	61	.13	66
Sentence-build. (2)	38	.75	67	.14	72
Absurdities	49	.84	79	--	86
Sentence-build. (1)	47	.44	64	.22	72
Mixed Sentences	56	.37	70	.29	79
Average Interval:		.69		.195	
Progress Ratio:		+.35		-.62	

NOTE:- The deviation intervals shown in brackets are those which are more than two-thirds above or below the average for the year, and are not included in the calculations. The average shown is that of the remaining figures. This applies to all succeeding tables of this kind.
Year 12 has been omitted as it represents only 9 children.

TABLE 7

DOUGHERTY

(483 Children, Kansas, U.S.A.)

RELATIONAL THINKING.

Age:	5	6	7		8		9
Comprehension			3.0	.68	27.4	.64	51.7
Giving Change			4.5	.65	27.4	.54	48.3
Sentence-build. (2)			1.5	---	22.6	.53	41.4
Giving Date			10.4	---	14.5	1.10	51.7
Memory Drawing					6.5	.64	27.6
Average Interval:				.665		.69	
Progress Ratio:				+.15		+.19	

Age:	9		10		11		12
Comprehension	51.7	.47	69.4	.24	77.3	---	89.1
Giving Change	48.3	.80	77.6	--	77.3		
Sentence-build. (2)	41.4	.73	69.4	.16	75.0	--	84.8
Giving Date	51.7	.86	81.6	--	79.5		
Memory Drawing	27.6	.51	46.9	.19	54.5	.67	78.3
Absurdities	20.7	1.05	59.2	.18	65.9	.37	78.3
Sentence-build. (1)	34.5	.85	67.3	.59	84.9	--	91.3
Mixed Sentences	3.4	--	16.3	(.81)	43.2	.39	58.7
Definition (Abstr)					15.2	.64	34.8
Problems					18.2	.40	30.4
Average Interval:		.75		.27		.49	
Progress Ratio:		+.29		-.53		-.16	

NOTE: Actual percentages are not given by the author, and these have been calculated by the present writer on the same statistical assumptions as those of the Binet data, described below.

The percentages for the "Five Weights" test show a decrease instead of an increase at age 9, and this series has therefore been omitted.

Burt's series of percentages is a complete one and will serve in some respects as a guide to our evaluation of the other less complete series of data. As intervals lying wholly below 25% are not considered, the number of tests which appear in any one year-interval is in itself significant in a complete series such as this. The high progress ratios at 5-6 and 6-7 must therefore be considered in conjunction with the small number of tests which have reached the 25% level by that time. On the other hand, the decline in progress noticeable at 8-9, with the subsequent increase at 9-10, can have little to do with this factor. There are already six tests at 7-8, seven at 8-9, and eight at 9-10. Previous to that there are only three at 6-7, and one at 5-6. Relational thinking can therefore be said to begin seriously only at 7 - a fact which is in agreement with our qualitative analysis in Table 2. In the year 7-8 the progress ratio is +.35, or 35% above the average; in the following year it falls to -.25, or 25% below average, rising again to +.10 in year 9-10. Thereafter it falls to -.22 and -.24 in the two remaining years.

The other four tables suffer from a scantiness of data in various year-intervals, such that it would not be possible to treat any one of them as authoritative if taken by itself. But it is interesting to note that the same decrease from 7-8 to 8-9 appears in two of them, and the increase from 8-9 to 9-10 is found in them all. In addition to this, three out of the four (Goddard being the exception) agree with Burt in showing a decline once more after year 10. In these tables also it is clear from the actual percentages at year 7 that relational thinking has no appreciable presence before that age. The one exception is to be found in Rowe's "Giving Change", where the percentage at 6 is 48 as against Burt's 10.9.

TABLE 8

BURT

(729 mentally defective children)

NON-RELATIONAL THINKING
(connected with environment)

Age:	5		6		7		8		9
4 Pennies			71.9	.40	83.6	--	94.2	--	95.1
2 Lines			65.6	.65	85.2	--	94.2	--	96.3
Copying Square			56.2	.50	74.5	.52	91.3	--	92.6
Chooses prettier			46.9	.86	78.2	--	88.4	--	88.9
4 Colours			37.5	.77	67.3	.24	75.4	--	86.4
Fingers			25.0	.79	45.5	.49	72.5	.34	82.7
13 Pennies			21.9	.53	40.0	.76	69.6	.48	83.9
Picture Description			18.7	.82	47.3	.38	62.3	(.09)	65.4
2 Weights			15.6	.56	32.7	.69	59.4	.44	75.3
4 Coins			12.5	.44	25.5	.75	53.6	.45	70.4
Right and Left			9.5	.92	38.2	.46	56.5	(.08)	59.3
Copying Diamond			3.1	1.07	36.4	.29	47.8	.36	61.7
Divided Card			6.2	--	21.8	.65	44.9	.33	57.9
Pence & Halfpence				--	1.8	--	24.6	.26	33.3
Missing Features				--	5.5	.64	27.5	.25	36.2
9 Coins				--	3.6	--	8.7	--	23.2
Average Interval:				.69		.53		.36	
Progress Ratio:				+.26		-.03		-.34	

Age:	9		10		11		12
4 Pennies	95.1	--	97.4	--	99.2	--	100.0
2 Lines	96.3	--	96.5	--	99.2	--	100.0
Copying Square	92.6	--	97.4	--	98.3	--	99.1
Chooses prettier	88.9	--	91.3	--	98.3	--	97.1
4 Colours	86.4	--	93.0	--	98.3	--	97.1
Fingers	82.7	--	90.3	--	97.2	--	98.1
13 Pennies	83.9	--	90.3	--	98.3	--	98.1
Picture Descrpt.	65.4	.69	86.7	--	90.8	--	90.5
2 Weights	75.3	--	87.7	--	91.7	--	93.3
4 Coins	70.4	.42	83.2	--	93.5	--	98.1
Right and Left	59.3	.56	78.8	--	85.2	--	94.3
Copying Diamond	61.7	.35	74.3	.48	88.9	--	96.2
Divided Card	57.9	.29	69.0	.48	83.3	--	88.6
Pence & Halfpence	33.3	.60	56.6	.63	78.7	--	89.5
Missing Features	36.2	.72	64.6	.40	77.8	--	80.0
9 Coins	23.2	(.08)	25.7	.84	57.4	.52	76.2
Suggestion	9.9	--	12.4	--	16.7	.54	33.3

TABLE 8 (Continued)

Age:	9		10		11		12
Average Interval:		.518		.566		.53	
Progress Ratio:		-.06		+.03		-.04	

TABLE 9

BURT

(M.D. Children)

RELATIONAL THINKING.

Age:	5		6		7		8		9
Comprehension (3)			3.1	--	9.1	--	24.8	.60	46.9
Giving Date							4.3	--	18.5
Giving Change							1.4	--	8.6
Five Weights							0.9	--	6.2
Sentence-build.(2)								--	3.4
Picture Interp. etc.							1.4	--	4.9
Average Interval:								.60	
Progress Ratio:								+.58	

Age:	9		10		11		12
Comprehension (3)	46.9	.34	60.2	.36	73.2	.29	81.9
Giving Date	18.5	.45	32.7	.40	48.1	.18	55.2
Giving Change	8.6	.83	34.5	.26	44.5	(.49)	63.8
Five Weights	6.2	--	17.7	.26	25.0	.16	30.5
Sentence-build.(2)	3.4	--	9.7	--	13.9	--	17.1
Picture Interp.	4.9	--	15.0	--	15.7	--	20.0
Memory Drawing	1.2	--	6.2	--	13.0	--	23.8
Absurdities etc.	2.5	--	3.5	--	7.4	--	11.4
Average Interval:		.54		.32		.21	
Progress Ratio:		+.42		-.16		-.45	

FIGURE 1. (Cont.)

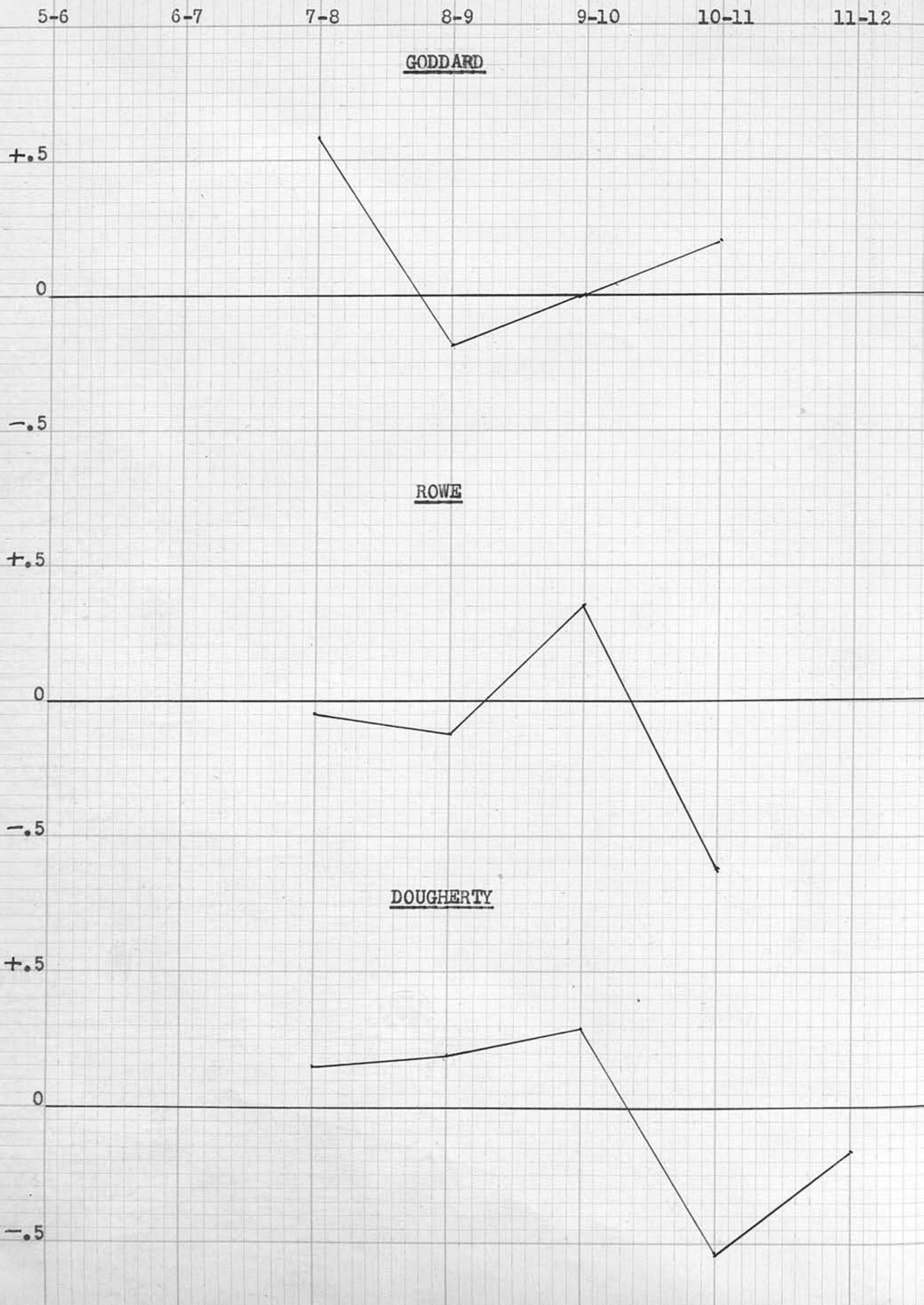
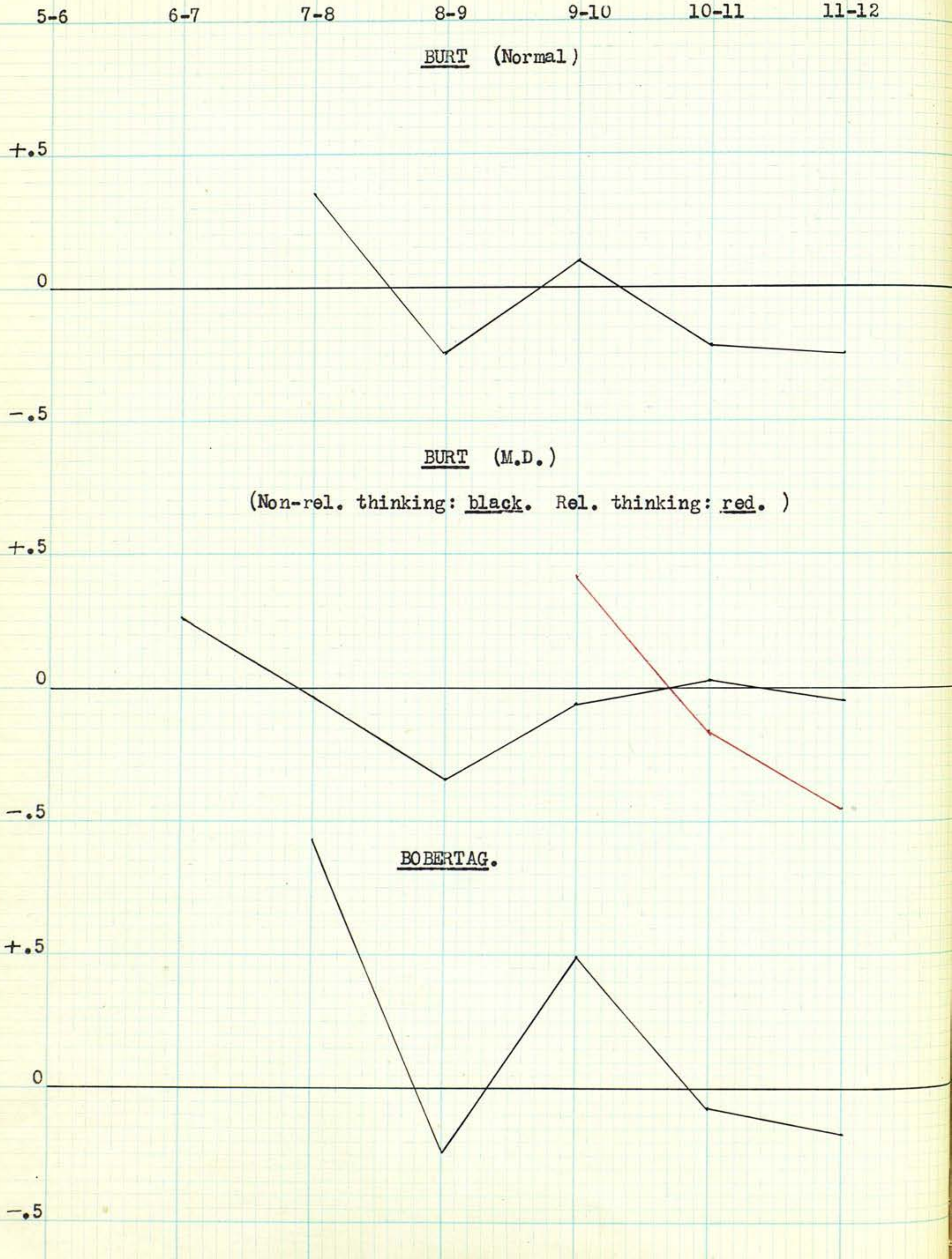


FIGURE 1.



5-6
6-7
7-8
8-9
9-10
10-11
11-12
BURT (Normal)
+.5
0
-.5
BURT (M.D.)
(Non-rel. thinking: black. Rel. thinking: red.)
+.5
0
-.5
BOBERTAG.
+.5
0
-.5

Table 8 gives Burt's data for mentally defective children, in respect of non-relational thinking connected with the immediate environment. It will be seen that we have here again a zero-point at age 9, with an increase in the rate of progress at 10.

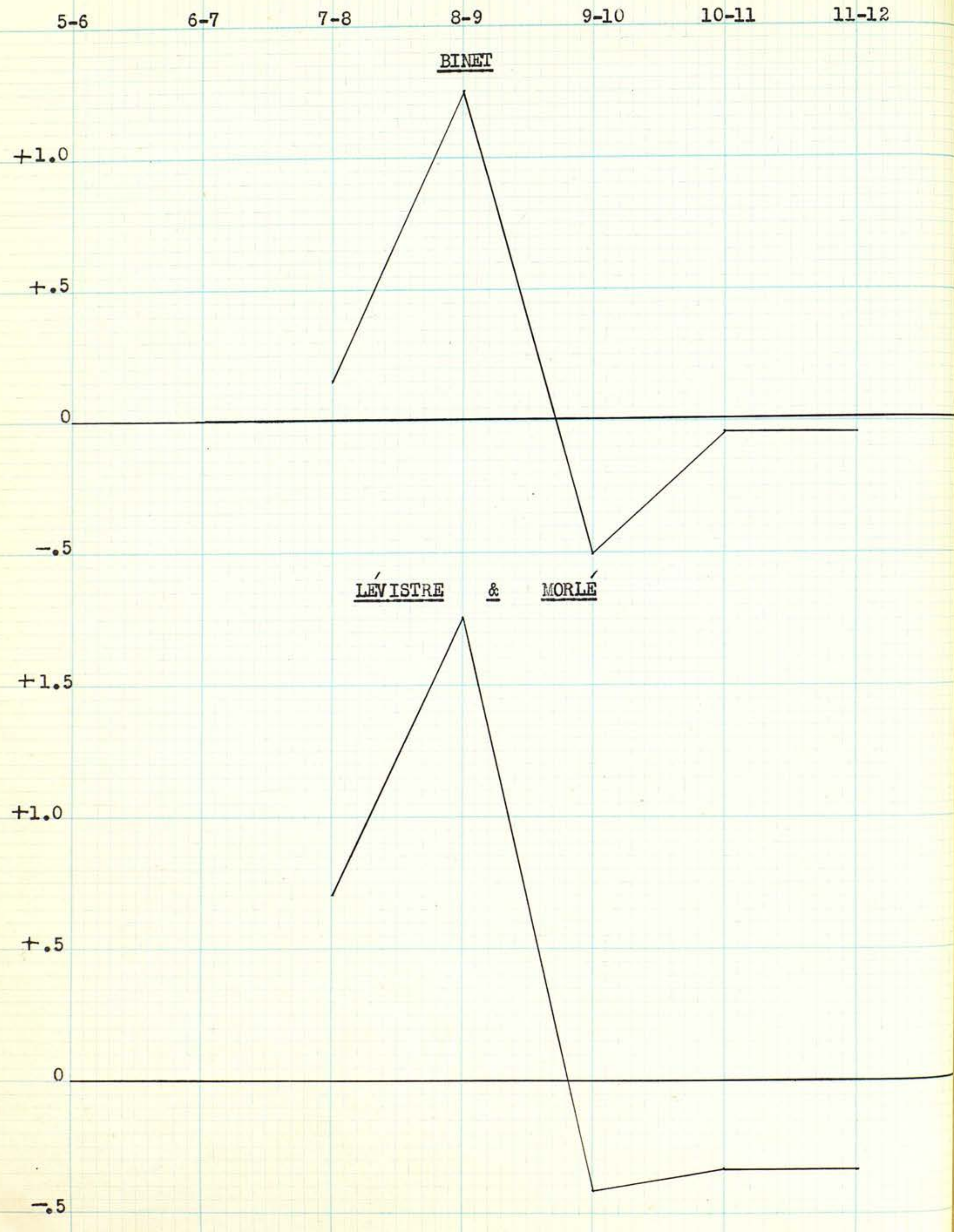
Table 9 gives the figures for relational thinking for the same children. As far as relational thinking goes with these children, it appears to begin at 10; but it will be noted that the tests concerned involve only concrete ideas in relation. The cognition of complex ideas in relation is apparently beyond the powers of the mentally defective. (The "Absurdities" test reaches only 19.6% at age 14, in Burt's table.) At 10 they have reached the same stage as the normal child at 7. There is an increase of progress with them, as with normal children, at 10, but "structurally" they are exactly one "phase" behind.

Figure 1 shows all these results in graphic form, the horizontal axis representing the average interval for the series, and the vertical axis the rate of progress above or below that average.

Turning now to Binet's figures, we find (pp. 150-151) two tables, one consisting of data obtained from Binet's own experiments, the other representing data obtained by Lévistre and Morlé on behalf of Binet. Binet describes the latter table as a "norm"; but the other is in a raw state, and he points out that the actual number of passes and failures for any given test below or above the normal age for that test, must not be accepted as it stands. In the case of tests below the normal for any given year, allowance must be made for the fact that only doubtful cases would be given such tests, and that the other children to whom the test was not given must be credited with a pass. Similarly, in the case of between the years 10 and 12 have been halved. On this account we cannot be certain of the behaviour of the graphs after year 10.

As in some previous cases, the number of tests represented is meagre; but the two graphs, derived from independent sources, seem to agree.

FIGURE 2.



T A B L E 10.

B I N E T

(Parisian Children.)

RELATIONAL THINKING

Age:	5		6		7		8		9
Giving Change					10	.92	39	1.59	92
Five Weights					17	.29	25	.75	53
Average Interval:						.605		1.17	
Progress Ratio:						+.16		+1.25	

Age:	9		10		11,		12
Five Weights	53	.12	58				
Sentence-build.(2)	24	(.56)	44	.595	-	.595	85
Absurdities	27	.11	31	.525	-	.525	71
Comprehension (4)	20	.29	29	.595	-	.595	74
Abstract Defin.	8	.51	25	.18	-	.18	38
Sentence-build.(1)	16	--	21	.81	-	.81	79
Mixed Sentences	6	--	21	.64	-	.64	68
Picture Interp.		--	6	.29	-	.29	26
Problems		--	4	.37	-	.37	29
Average Interval:		.257		.50		.50	
Progress Ratio:		-.51		-.04		-.04	

NOTE: The figures for "Giving Date" could not be used owing to a fluctuation in the resulting percentages, these being, for years 7, 8, and 9, 66%, 30%, and 100%, respectively. "Comprehension (3)" is already 78% at 9, and no figures are given below that year.

TABLE 11.

L E V I S T R E AND M O R L É

(Parisian Children)

RELATIONAL THINKING

Age;	5		6		7		8		9
Giving Date					40	1.09	80		
Giving Change						--	40	2.01	100
Comprehension (3)						--	20	2.06	90
Five Weights						--	10	1.22	50
Average Interval:						1.09		1.76	
Progress Ratio:						+.70		+1.75	

Age:	9		10		11		12
Five Weights	50	.25	60				
Absurdities	40	.25	50	.42	-	.42	80
Memory Drawing	40	.25	50				
Sentence-build.(2)	30	.52	50	.42	-	.42	80
Comprehension (4)	30	(.00)	30	.52	-	.52	70
Sentence-build.(1)	20	.59	40	.545	-	.545	80
Mixed Sentences	10	(.85)	40	.385	-	.385	70
Definition (Abstr.)	10	--	20	.295	-	.295	40
Average Interval:		.37		.43		.43	
Progress Ratio:		-.42		-.33		-.33	

FIGURE 3.

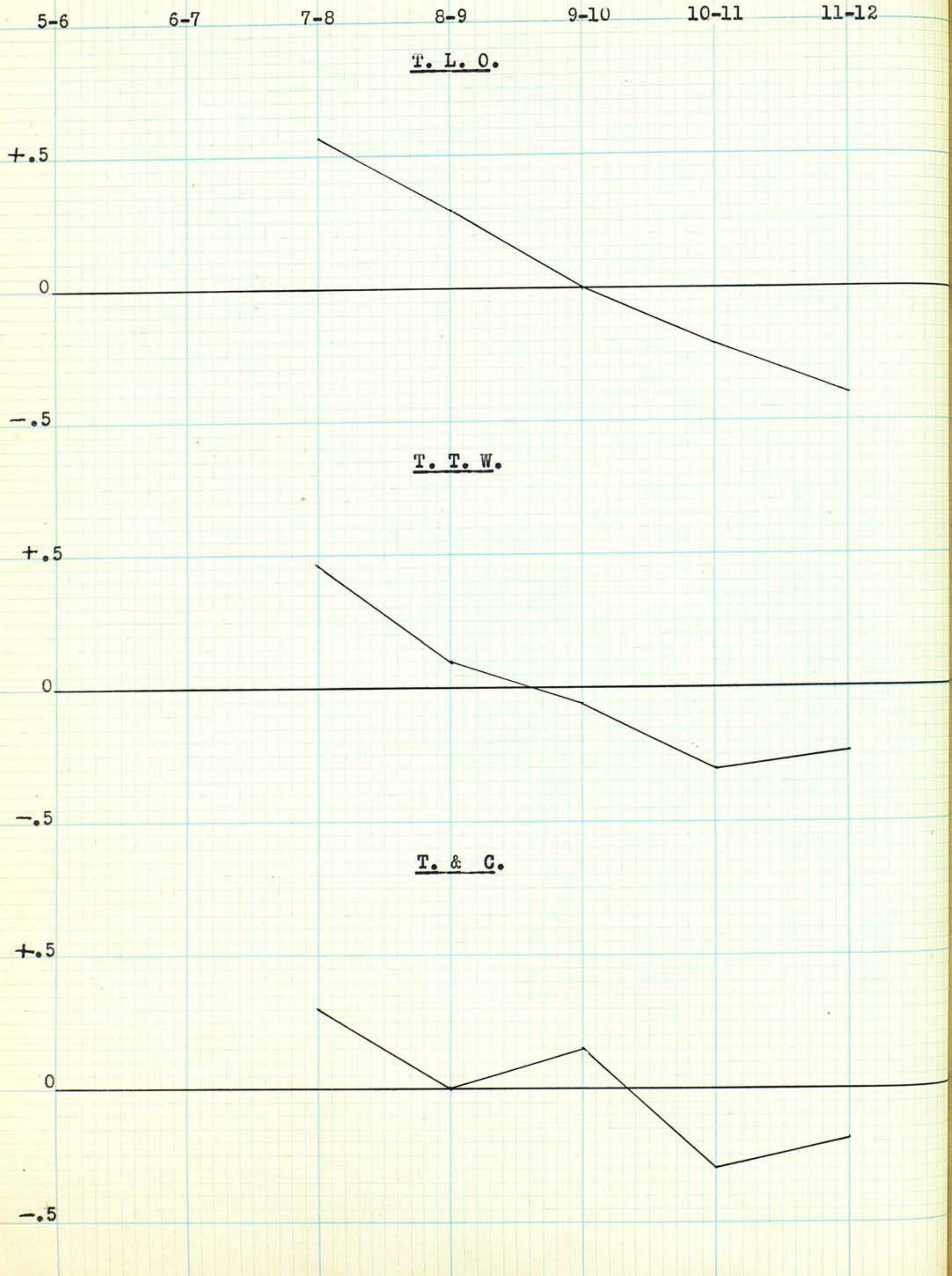


TABLE 12.

TERMAN, LYMAN, ORDAHL, etc.

(725 Children, California and Nevada, U.S.A.)

RELATIONAL THINKING

Age:	5		6		7		8		9
Comprehension (3)			47	.31	59	.35	72	.46	85
Similarities			30	.55	51	.30	63	.44	78
Giving Date				--	20	.84	50	.44	67
Giving Change				--	3	1.08	38	.56	60
Five Weights				--	7	.88	35	.59	58
Sentence-build. (1)				--		--	44	.62	68
Absurdities				--		--	16	.91	47
Memory Drawing				--		--	27	.51	46
Average Interval:				.43		.69		.566	
Progress Ratio:				-.02		+.57		+.29	

Age:	9		10		11		12
Comprehension (3)	85	--	92				
Similarities	78	--	90	--	92		
Giving Date	67	.51	83	--	91		
Giving Change	60	.70	83	--	92		
Five Weights	58	.30	69	.17	75	--	79
Sentence-build. (1)	68	.41	81	--	90	--	95
Absurdities	47	.44	64	(.08)	67	.23	75
Memory Drawing	46	.35	60	.33	72	.30	81
Comprehension (4)	44	.40	60	.39	74	.31	83
Fable Interp.		--	37	.41	53	.23	62
Mixed Sentences		--	25	(.64)	49	.34	62
Abstract Defin.		--	27	.56	48	.23	57
Picture Interp.		--	42	.20	50	.33	63
Similarities (3)		--	43	.36	57	.18	64
Problems		--		--	31	.22	39
Average Interval:		.44		.345		.263	
Progress Ratio:		.00		-.22		-.40	

T A B L E 13.

T E R M A N, T R O S T, and W A D D L E.

(265 Children, California, U.S.A.)

RELATIONAL THINKING

Age:	5		6		7		8		9
Comprehension (3)			20	.87	51	.28	62	.27	72
Giving Date				---	14	1.02	48	.60	71
Giving Change				---	0	.81	29	.86	62
Five Weights				---		---	50	.55	71
Sentence-build. (1)				---		---	38	.52	68
Absurdities				---		---	29	.55	50
Memory Drawing				---		---	36	.36	50
Average Interval:				.87		.70		.53	
Progress Ratio:				+.81		+.46		+.10	

Age:	9		10		11		12
Comprehension (3)	72	.30	81				
Giving Date	71	.52	86	---	94		
Giving Change	62	.46	78	---	91		
Five Weights	71	(.06)	73	.31	82		
Sentence-build. (1)	68	.60	86	---	91	---	90
Absurdities	50	.55	71	.29	80	---	85
Memory Drawing	50	.28	61	.30	72	.54	90
Comprehension (4)	45	.44	62	(.08)	65	.38	78
Mixed Sentences		---	37	.33	50	.18	57
Picture Interp.		---	30	.44	47	.47	65
Problems		---		---	38	.31	50
Average Interval:		.45		.33		.376	
Progress Ratio:		-.06		-.30		-.23	

TABLE 14

TERMAN and CHILDS

(342 Children, California, U.S.A.)

RELATIONAL THINKING

Age:	5	6		7		8		9
Comprehension (3)		38	.49	57	.32	69	.27	78
Giving Date			--	25	.72	52	(.83)	81
Giving Change			--	7	.58	26	.44	42
Five Weights			--	25	(.12)	29	.68	55
Sentance-build. (1)			--		--	42	.45	60
Absurdities			--		--	30	.27	40
Average Interval:			.49		.54		.42	
Progress Ratio:			+.17		+.30		.00	

Age:	9		10		11		12
Comprehension (3)	78	--	85				
Giving Date	81	--	77	--	87	--	93
Giving Change	42	.33	55	.31	67		
Five Weights	55	--	54	--	77		
Sentence-build. (1)	60	.74	84	--	86	--	93
Absurdities	40	.30	52	(.08)	55	.48	73
Comprehension (4)	37	.56	59	.29	70	.32	80
Mixed Sentences		--	24	.24	32	(.78)	62
Fable Interp.		--	44	.35	58	.24	67
Definition (Abstr.)		--	20	(.53)	38	.34	51
Problems		--		--	40	(.02)	41
Average Interval:		.48		.297		.345	
Progress Ratio:		+.15		-.29		-.18	

NOTE: As the percentage for "Five Weights" is lower at age 10 than at 9, the figures have not been used after age 9.

The percentages used are taken from "Stanford Revision of the Binet-Simon Scale."

Considering now the three series of data associated with Terman, the results of which are seen in tables 12, 13, and 14, and in graphic form in figure 3, we find that only the Terman and Childs data show evidence of a slower rate of progress at 8-9 than at 9-10. The high point at 7-8, however, is again evident; and although figures are not given for any test below age 7 - with the exception of "Comprehension" and "Similarities" - it is evident from the other percentages at 7 that there is no appreciable relational thinking before that age.

If we now examine the data for tests involving non-relational thinking of the type not connected with the immediate environment, we find rather different tendencies. Results of Burt's children - both normal and M.D. - and those of Rowe are seen in tables 15, 16, and 17, and in graphic form in figure 4. In the case of the normal children, the highest point of development of this type of mental process is year 5-6. There are no figures for the mentally defective children at 5, but it is clear that a very substantial step forward is made by these children at 6-7. All three graphs show a descent to the year 8-9 after which there is a change in direction, Rowe increasing rapidly once more to year 10 (as in relational thinking), while Burt's graphs maintain the 8-9 rate of development with a tendency to descrease once more toward year 12. The similarity of the development of Burt's normal and M.D. children is again noteworthy.

The results for this type of thinking derived from Terman's three series are given in tables 18, 19, and 20, and graphically in figure 5. The peak of development is here at 5-6, 6-7, or both years together, with a descent in all three to year 7-8, and a rise at 8-9.

Dougherty's figures commence only at 7-8, but as far as year 10 (table 21) they approximate to those of Terman. (See figure 5.)

FIGURE 4.

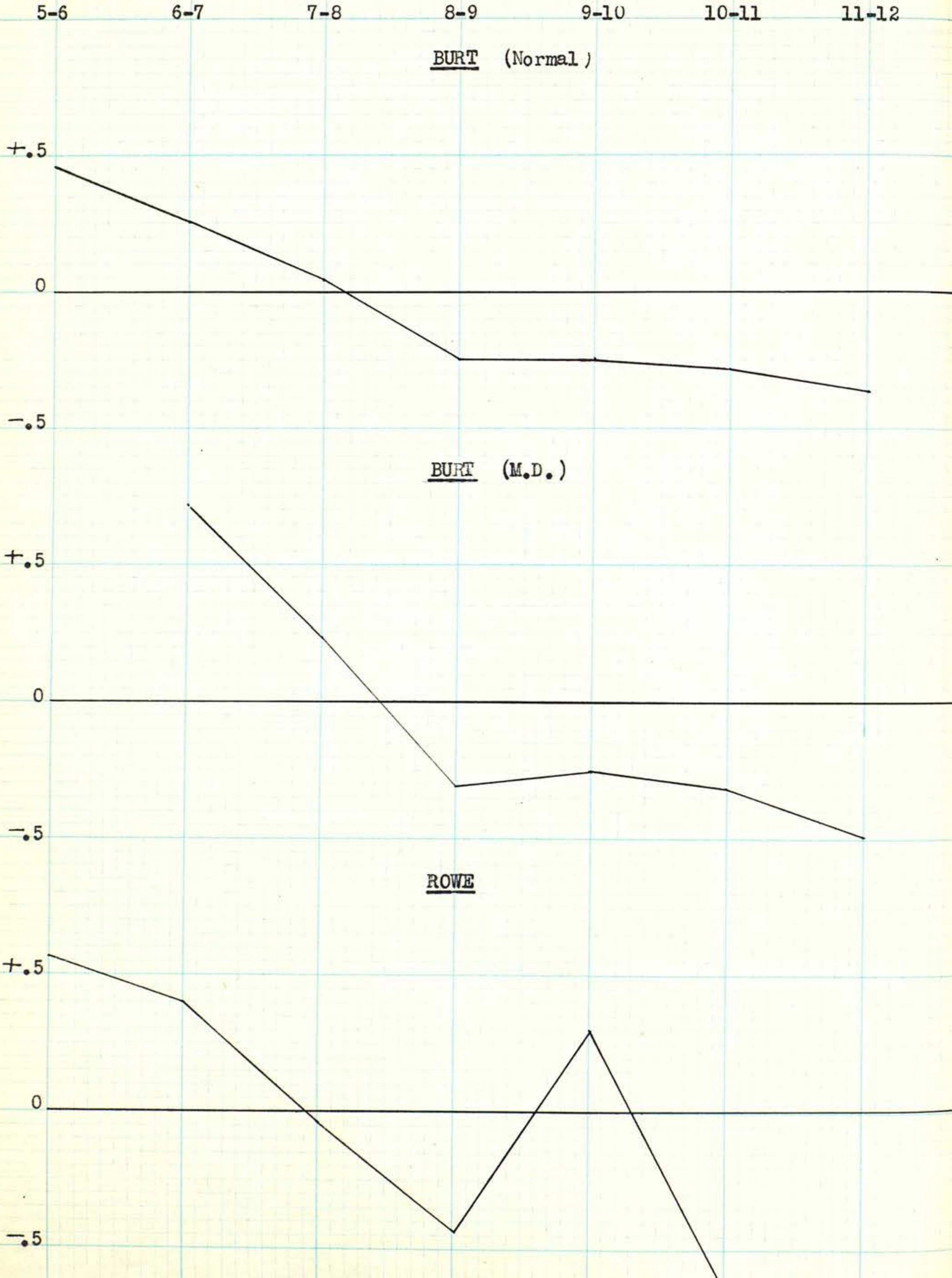


TABLE 15.

BURT

(London Children.)

NON-RELATIONAL THINKING.
(unconnected with environment)

Age:	5		6		7		8		9
4 Digits	72,3	.66	94.8	--	96.1	--	98.9	--	100.0
Days of Week	44.2	1.04	81.3	--	93.9	--	95.6	--	97.6
Definition (use)	46.2	.69	72.3	.52	87.2	--	94.2	--	97.1
5 Digits	37.3	1.02	75.7	--	94.0	--	95,6	--	98.8
16 Syllables	47.8	.66	72.7	.44	85.3	--	95.2	--	98.6
Concrete Differ.	28.3	.62	52.0	.49	70.6	.30	80.0	--	92.9
Counting 20-0	5.7	.65	28.0	.67	53.6	.62	76.0	--	86.1
6 Digits	4.9	--	14.5	.86	42.5	.45	60.2	.52	78.2
Months	1.3	--	7.0	.82	35.3	.68	61.6	.49	78.6
Reading (2 facts)	3.9	--	23.2	.94	58.2	.71	82.1	--	90.5
Reading (6 facts)	0.0	--	3.8	--	19.3	.69	44.5	.62	68.4
Definition (descr.)	3.9	--	16.4	--	23.6	.48	40.4	.59	63.8
60 Words	0.0	--	4.1	--	7.6	--	21.6	.18	27.0
7 Digits	0.0	--	2.5	--	5.8	--	18.8	.23	25.5
Three Rhymes	0.0	--	0.0	--	3.4	--	20.2	.21	26.6
26 Syllables	0.0	--	0.0	--	1.8	--	4.3	--	9.7
Average Interval:		.76		.677		.56		.405	
Progress Ratio:		+.41		+.25		+.04		-.25	

Age:	9		10		11		12
6 Digits	78.2	--	88.5	--	96.6	--	98.5
Months	78.6	--	93.5	--	98.3	--	100.0
Reading (6 facts)	68.4	.37	80.2	--	89.3	--	95.7
Definition (descr.)	63.8	.39	77.0	--	86.6	--	87.0
60 Words	27.0	.45	43.6	.42	60.4	.39	74.3
7 Digits	25.5	.52	44.6	.38	59.4	.25	68.9
Three Rhymes	26.6	.30	37.3	.37	52.0	.37	66.4
26 Syllables	9.7	--	17.4	-	22.0	.36	34.1
Average Interval:		.406		.39		.34	
Progress Ratio:		-.25		-.28		-.37	

T A B L E 17.

R O W E

(Michigan Children.)

NON-RELATIONAL THINKING
(unconnected with environment)

Age:	5		6		7		8		9
Counting 20-0	29	.91	64	.84	90	--	93	--	87
Days of Week	3	--	9	.83	35	.59	58	.35	71
5 Digits	3	--	24	.76	52	.39	67	.17	73
Definition (Descr)				--	12	.69	33	.47	51
Months				--	22	.92	56	.16	62
6 Digits				--	20	.29	29	.47	47
60 Words				--	8	.51	25	(.70)	51
Three Rhymes				--	0	--	12	--	18
7 Digits				--	0	--	24	.35	36
Average Interval:		.91		.81		.565		.328	
Progress Ratio:		+.57		+.40		-.03		-.43	

Age:	9		10		11	12
Days of Week	71	.70	94	--	100	
5 Digits	73	.57	91	--	93	
Definition (descr.)	51	1.00	85	--	86	
Months	62	1.00	94	--	90	
6 Digits	47	1.00	82	--	69	
60 Words	51	.78	79	--	79	
Three Rhymes	18	.48	33	.13	38	
7 Digits	36	.49	55	.28	66	
Average Interval:		.75		.205		
Progress Ratio:		+.30		-.65		

FIGURE 5. (Cont.)

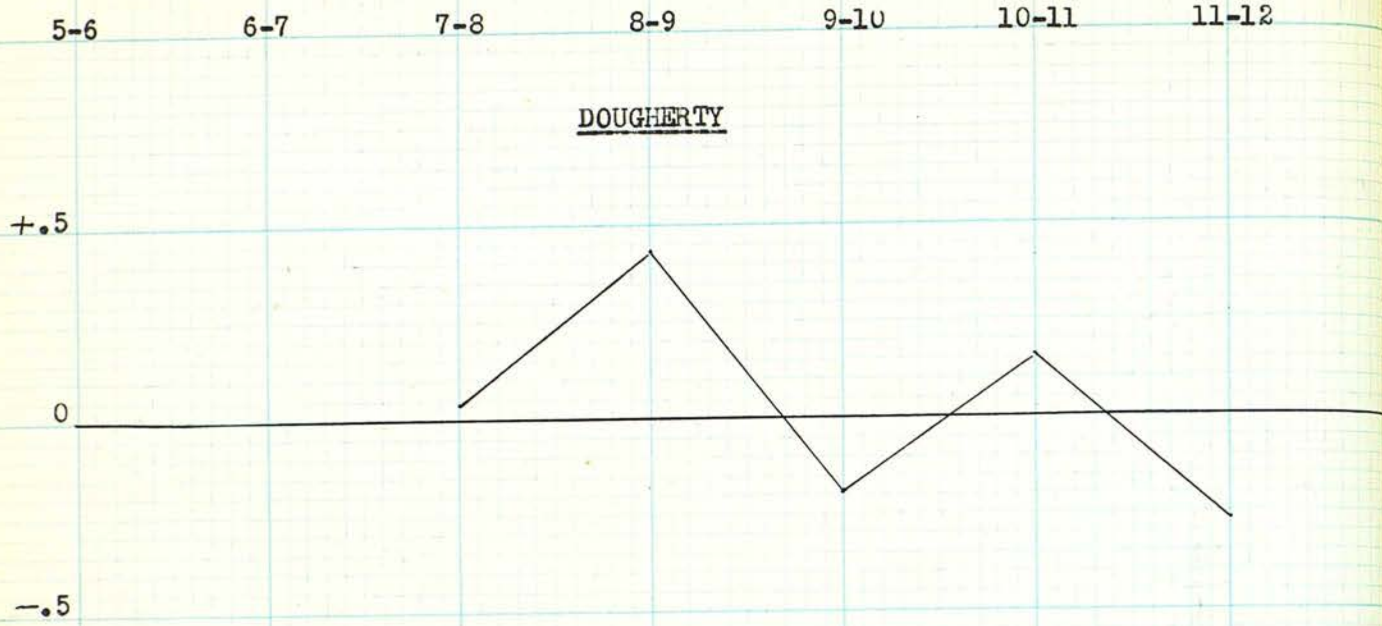
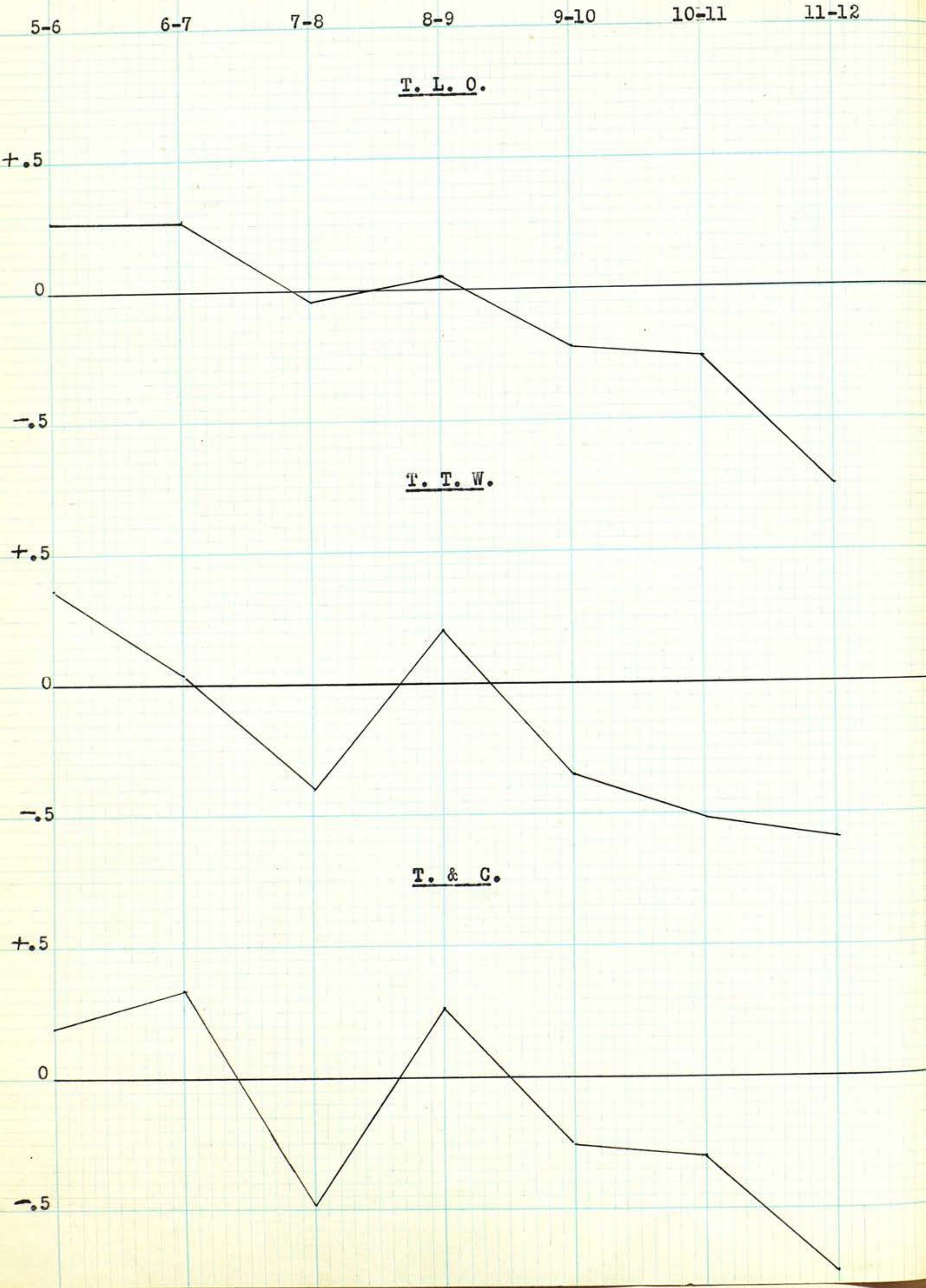


FIGURE 5.



T A B L E 18.

<u>T E R M A N</u>, <u>L Y M A N</u>, <u>O R D A H L</u>.

(Californian Children)

<u>NON-RELATIONAL THINKING</u>.
(unconnected with environment)

Age:	5		6		7		8		9
Definition (use)	69	.73	92	--	98				
Three Commissions	72	.61	91	--	93				
Comprehension (2)	55	.39	70	.55	86	--	93		
16 Syllables	56	.35	69	.68	90	--	95		
Morning & Afternoon	60	.67	82	--	97				
5 Digits	34	.64	59	.41	74	.31	83	--	93
Concrete Differ.	23	.84	54	.31	66	.36	78	--	90
Days of Week	0	.71	27	1.00	65	.49	81	--	91
3 Digits Backwds.	2	1.00	35	.64	60	.70	83	--	90
Counting 20-0		--	16	1.04	48	.36	66	.47	81
Definition (descr.)		--		--	43	.49	62	.24	71
4 Digits Backwds.		--		--	18	.77	44	.46	62
Three Rhymes		--		--		--	48	.36	62
Months		--		--		--	30	.75	59
Reading (8 facts)		--		--		--	26	.77	55
60 Words		--		--		--	21	.81	50
6 Digits		--		--		--	32	.62	56
20 Syllables		--		--		--	35	.44	52
<u>Average Interval</u>:		.66		.66		.497		.546	
<u>Progress Ratio</u>:		+.27		+.27		-.04		+.05	

Age:	9		10		11		12
Counting 20-0	81	--	96				
Definition (descr.)	71	.40	83				
4 Digits Backwds.	62	.36	75	--	86	--	91
Three Rhymes	62	.57	81	--	83	--	94
Months	59	.54	78	--	90	--	93
Reading (8 facts)	55	.37	69	.34	80	--	93
60 Words	50	.33	63	.38	76	--	85
6 Digits	56	.40	71	.29	80	--	87
20 Syllables	52	.28	63	.38	76	--	82
5 Digits Backwds.		--	40	.53	61	.13	66
7 Digits		--		--	36	.13	41
<u>Average Interval</u>:		.406		.38		.13	
<u>Progress Ratio</u>:		-.22		-.26		-.75	

TABLE 19.

TERMAN, TROST, WADDLE

(Californian Children)

NON-RELATIONAL THINKING.
(unconnected with environment)

Age:	5		6		7		8		9
16 Syllables	38	.75	67	.30	77	--	86		
Morning & Afternoon	68	.67	88	--	95				
5 Digits	26	.46	43	.82	74	.20	80		
Concrete Differ.	30	.80	61	.36	74	.20	86	--	91
Counting 20-0		--	19	.57	38	.49	57	.74	82
Reading (8 facts)		--		--		--	30	.52	50
60 Words		--		--		--	32	.50	51
Average Interval:		.67		.51		.296		.586	
Progress Ratio:		+.37		+.04		-.40		+.20	

Age:	9		10		11		12
Counting 20-0	82	--	97				
Reading (8 facts)	50	.36	64	.28	74	.17	79
60 Words	51	.28	62	.19	69	(.68)	90
7 Digits		--		--	37	.23	46
Average Interval:		.32		.235		.20	
Progress Ratio:		-.35		-.52		-.59	

TABLE 20

TERMAN AND CHILDS

(Californian Children)

NON-RELATIONAL THINKING
(unconnected with environment)

Age:	5		6		7		8		9
16 Syllables	53	.23	62	.53	80				
5 Digits	50	(.00)	50	.58	72	(.06)	74	.31	83
Concrete Differ.	19	.96	47	(.23)	62	.33	74	.40	85
Days of Week		--	56	.89	85	--	85	--	98
Counting 20-0		--	7	(1.66)	62	.19	69	.78	95
Definition (descr.)		--		--	34	(.61)	58	.54	77
Months		--		--		--	64	.86	91
Reading (8 facts)		--		--		--	13	.99	46
60 Words		--		--		--	35	.57	57
Average Interval:		.595		.666		.26		.636	
Progress Ratio:		+.19		+.33		-.48		+.27	

Age:	9		10		11		12
Counting 20-0	95	--	100				
Definition (descr.)	77	--	89				
Months	91	--	81	--	96		
Reading (8 facts)	46	.30	58	.19	65	--	62
60 Words	57	.26	67	.51	83	--	82
7 Digits		--		--	43	.13	48
Three Rhymes	74	.55	92	--	81	--	82
Average Interval:		.37		.35		.13	
Progress Ratio:		-.26		-.30		-.74	

NOTE: The percentages used are taken from "The Stanford Revision of the Binet-Simon Scale".

TABLE 21

DOUGHERTY.

(Kansas Children)

NON-RELATIONAL THINKING
(unconnected with environment)

Age:	5		6		7		8		9
Counting 20-0					46.3	.90	79.0	--	89.7
Days of Week					68.7	.70	90.3	--	98.3
Definition (Descr.)					28.4	.53	48.4	.80	77.6
6 Digits					16.4	.69	38.7	.94	74.1
Months					0.0	--	11.3	1.17	50.0
Average Interval:						.705		.97	
Progress Ratio:						+.04		+.43	

Age:	9		10		11		12
Definition (Descr.)	77.6	--	77.6	--	81.8		
6 Digits	74.1	.25	81.6	--	75.0	--	87.0
Months	50.0	.76	77.6	--	84.1		
60 Words	20.7	.59	40.8	.77	70.5	.56	87.0
Rhymes	17.2	.61	36.7	.81	68.2	.56	84.8
7 Digits					27.3	.38	41.3
26 Syllables					27.3	.49	45.7
Average Interval:		.55		.79		.497	
Progress Ratio:		-.19		+.16		-.27	

The series derived from Bobertag and Goddard are incomplete, (tables 22 and 23, and figure 6). The break in the Bobertag graph is due to the two tests at 8-9 yielding intervals too remote from their own average. If, however, we were to ignore the smaller and accept the larger as representative, we have still evidence of a decrease at 8-9, as in Burt and Rowe, with a revival at 9-10.

Both these graphs show a later peak of development, namely, at 6-7 and 7-8.

The Binet and Lévistre and Morlé figures, like those of Dougherty, commence only at 7-8, and are seen in tables 24 and 25, with graphs in figure 7. They are very similar in tendency, and, like the graphs for relational thinking from the same sources, show a sudden decrease to year 9-10. They do not, however, show us the beginnings of the development of this type of thinking.

We have, however, two additional sets of data which show the development of this level of thought between ages 5 and 7. Irene Cuneo and L.M. Terman published in 1918 (23) percentages of passes of 112 Kindergarten children, details of which, in regard to this type of thinking, are given in table 26. It will be seen that there is a very marked increase in rate of development at 6-7, the 5-6 interval showing an average of .378 and that of year 6-7 an average of .945.

A similar result was found in test data obtained by the writer from Moray House School, Edinburgh. All the children there are tested by the headmistress of the infant department as soon as they enter school, and sometimes later also. The number of cases obtained, which are spread over a period of eight years, is as follows: 251 children at 5 years, 24 at 6 years, and 44 at 7 years. The average age for the 5-year-olds was

FIGURE 6.

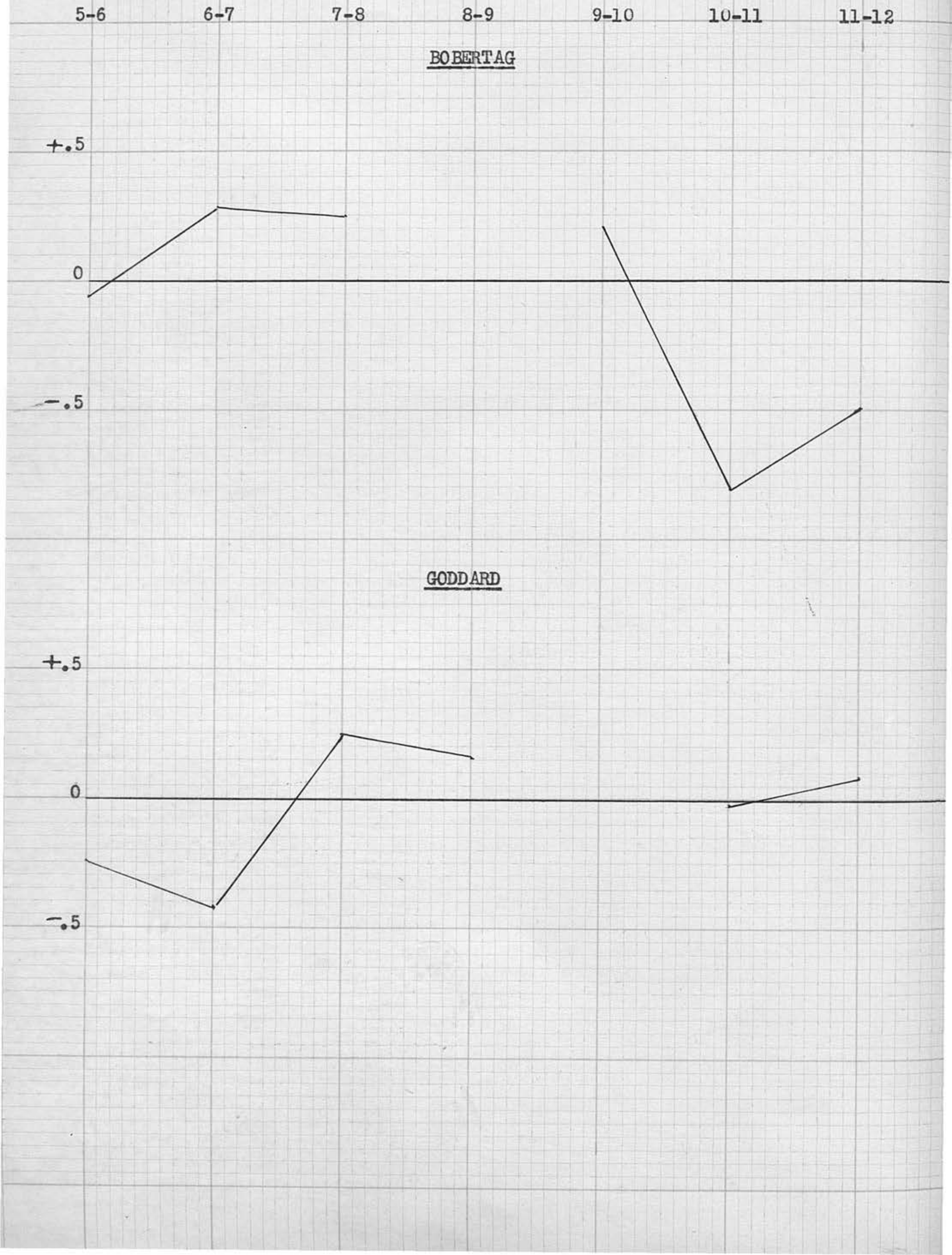


TABLE 22.

BOBERTAG.

(Breslau Children)

NON-RELATIONAL THINKING
(unconnected with environment)

Age:	5		6		7		8		9
Morning & Afternoon			45	.63	69				
5 Digits	20	.64	42	.94	77	--	92		
Concrete Differ.			16	1.05	52	.56	73	(.61)	93
Counting 20-0				--	46	1.14	85		
6 Digits					22	.85	53	(.02)	54
Average Interval:		.64		.87		.85		--	
Progress Ratio:		-.06		+.28		+.25		--	

Age:	9		10		11		12
6 Digits	54	.82	82	--	91		
7 Digits			21	.13	25	--	25
Three Rhymes				--	34	.41	50
60 Words				--	60	.28	70
Average Interval:		.82		.13		.345	
Progress Ratio:		+.21		-.81		-.49	

TABLE 23.

GODDARD

(New Jersey Children)

NON-RELATIONAL THINKING
(unconnected with environment)

Age:	5		6		7		8		9
16 Syllables	0.0	--	15.6	.36	25.9				
Definition (use)	60.0	.80	85.3	--	92.0		100		
Age	50.0	.89	81.4	--	95.1				
Morning & Afternoon	56.0	.42	71.4	.70	95.7				
5 Digits		--	20.6	(1.49)	74.7	(.31)	83.7		
Reading (2 facts)		--		--	7.1	1.05	40.7	.83	72.2
Counting 20-0		--		--	26.5	1.59	83.1	--	94.1
Concrete Differ.		--		--	73.5	.64	97.7	--	94.4
Days of Week		--		--	54.2	1.28	95.5	--	100
Reading (6 facts)		--		--		--	24.1	1.58	81.1
Months		--		--		--	64.7	.78	88.8
Average Interval:		.70		.53		1.14		1.06	
Progress Ratio:		-.24		-.42		+.24		+.16	

Age:	9		10		11		12
Months	88.8	--	97.1				
60 Words		--	44.4	1.44	92.1		
7 Digits		--	21.6	.67	45.1	1.12	84.1
Three Rhymes		--	72.0	.59	90.0	--	100
26 Syllables		--		--	14.3	.86	41.6
Average Interval:		--		.90		.99	
Progress Ratio:		--		-.02		+.08	

FIGURE 7.

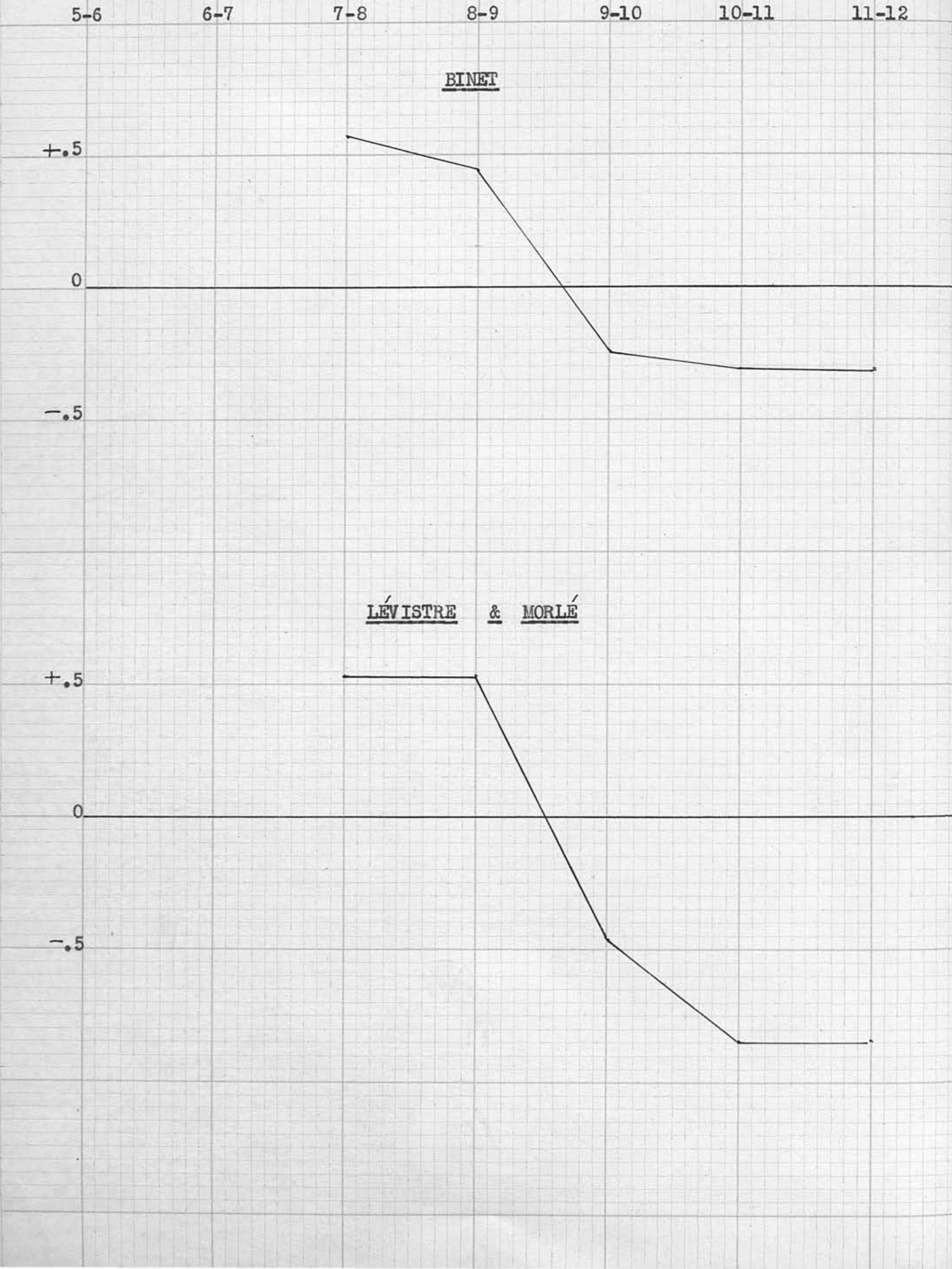


TABLE 24.

BINET

(Parisian Children)

NON-RELATIONAL THINKING
(unconnected with environment)

Age:	5		6		7		8		9
5 Digits					50	1.15	88		
Counting 20-0					40	1.25	84	--	96
Concrete Differ.					60	.56	79	--	96
Definition (descr.)					33	(.24)	42	.91	76
Average Interval:						.986		.91	
Progress Ratio:						+.57		+.44	

Age:	9		10		11		12
60 Words	10	.48	25	.53	--	.53	65
7 Digits			10	.40	--	.40	35
Three Rhymes			21	.365	--	.365	47
Average Interval:		.48		.43		.43	
Progress Ratio:		-.24		-.32		-.32	

TABLE 25.

LÉVISTRE and MORLE´

(Parisian Children)

NON-RELATIONAL THINKING.

(unconnected with environment)

Age:	5		6		7		8		9
5 Digits					20	.84	50		
Concrete Differ.					40	1.09	80		
Counting 20-0					30	1.75	90	--	100
Months						--	20	1.68	80
Definition (descr.)						--	30	.77	60
Average Interval:						1.226		1.225	
Progress Ratio:						+.53		+.53	

Age:	9		10		11		12
Definition (descr.)	60	.27	70				
60 Words	20	.59	40	.125	--	.125	50
Average Interval:		.43		.125		.125	
Progress Ratio:		-.46		-.84		-.84	

TABLE 26.

CUNEO AND TERMAN

(Californian Children)

NON-RELATIONAL THINKING
(unconnected with environment)

Age:	5		6		7
Three Commissions	73	.23	80	--	96
Age	44	.56	66	1.25	96
Comprehension (2)	62	.57	81	--	96
16 Syllables	40	.40	56	1.09	91
Morning & Afternoon	44	.15	50	.77	78
5 Digits	46	.20	64	1.15	91
Concrete Differ.	17	.54	34	.59	57
Counting 20-0	2	--	14	.79	39
Definition (descr.)	0	--	8	.98	39
Average Interval:		.378		.945	

TABLE 27.

MORAY HOUSE CHILDREN

NON-RELATIONAL THINKING
(unconnected with environment)

Age:	5		6		7
5 Digits	45.8	.54	66.6	1.01	100
Concrete Differ.	31.9	.68	58.3	1.23	97.7
Counting 20-0	3.2	.91	33.4	1.79	93.2
16 Syllables	55.4	.29	66.6	.83	93.2
Definition (descr.)	24.7	1.00	62.5	.84	88.6
Three Rhymes		--	8.3	1.22	47.7
4 Digits Backwds.		--	8.3	1.71	65.9
Average Interval:		.684		.985 (reduced by 1/5)	

5 years 4 months, that of the 6-year-olds 6 years 4 months, and of the 7-year-olds, 7 years 7 months. As the 6-7 year interval is thus 15 months while the 5-6 interval is exactly 12, the results (shown in table 27) in respect of the former interval have been reduced by one fifth. The average for year 5-6 is .684 and that for year 6-7 is .985.

To sum up those figures which show the progress of this level of thinking between the ages of 5 and 7, Burt (normal), Rowe, T.L.O. and T.T.W. show a marked progress at 5-6, continued in three of the four cases through 6-7 but with a tendency to decrease either during that year or immediately afterwards. On the other hand, T. and C., Bobertag, Cuneo and Terman, and the Moray House school data show a higher rate of progress at 6-7 than at 5-6. In Bobertag this continues through 7-8, while Goddard shows greatest progress at 7-8.

If we consider the seven complete graphs at our disposal - that is, including Bobertag and the Burt M.D. children, - we find that whether the highest point be at 5-6 or 6-7, a certain zero point is afterwards reached at either 7-8 or 8-9 after which the development takes a different course. Comparing this tendency with that of the development of relational thinking, it can be seen that the latter does not appear to arise out of the former, but that, in fact, relational thinking takes an important step forward in development just when the rate of progress of the simpler type of thinking is beginning to decline, or has already fallen below the average rate. This is especially noticeable in the three Terman graphs. Goddard appears to be the only clear exception. After this zero point in simple thinking, there is an increase in the rate of progress in Bobertag, Rowe, and the three Terman graphs, while in the case of Burt (normal and M.D.) the downward tendency is checked.

It is interesting to note at this point that the graphs from Burt's figures synchronise with the others in regard to these fluctuations, - in spite of the fact that his children are on the average six months older in each year. This can only mean that the bulk of the change in each case takes place during the first half of the year in question.

Summarising the results in regard to relational thinking, we find that out of the 10 graphs for normal children, 6 show the maximum rate of development during year 7-8, and 2 - Binet and Lévistre & Morlé - during 8-9. In regard to what takes place later, we have found two tendencies. In Burt, Bobertag, Goddard, and Rowe, there is a low rate of development at 8-9 with an acceleration at 9-10. Dougherty is above average at 8-9, but also shows an increase toward 9-10. In the French data, on the other hand, following the maximum acceleration at 8-9, there is a low interval at 9-10. Terman's Californian children seem to yield results between these two. There is a decrease at 8-9 without however any recovery at 9-10, except to a slight extent in T. & C.

From the percentages at our disposal we can infer that there is no substantial relational thinking below age 7.

With a view to examining at closer range the early development of these two types of thinking, by means of tests specially designed for the purpose, an experiment was devised and carried out by the writer with children of Moray House School, Edinburgh. Two tests were arranged - one which would involve elementary imagery-control, and the other involving relational thinking in an elementary form. The two tests were given at the same time to each child individually, every child in the school between the ages of 5 and 9 inclusive being tested. The tests were then repeated at a date which was exactly a year later for each child, and which therefore covered a range from 6 to 10. At the same time the new group of 5-year-olds was given the test, as well as all new-comers of ages 6 to 10.

There are thus two series of results, which can be treated independently; but as a considerable number in each series were the same children, we have also a series of actual retests of the age-intervals from 5 - 10.

In the first series there are 161 children (83 boys and 78 girls), and in the following year the number was 205 (100 boys and 105 girls), making a total of 366 individual tests (183 boys and 183 girls). Those retested among these numbered 144 (74 boys and 70 girls).

The first part of the test consisted in repetition of letters and digits in the reverse order, thereby excluding the factor of mere imitation or echoing so liable to be present in forward repetition. The letters comprised three words of three letters each, and one word of four letters; and the numbers likewise consisted of three of three digits and one of four. The three smaller numbers are those used in the Stanford-Binet (1916) alternative 7-year test, and the larger number is one of those used in test 4 of the 9-year level. The three smaller words were chosen so that they should represent various combinations of consonant and vowel. The words and numbers are as follows:

D O G	C R Y	A R M	C A R T
2 8 3	4 2 7	5 9 6	6 5 2 8

Except in the case of children in their first school year, the test was given in the following way:

In order to obviate any risk of the child not understanding what was required of him, the word " B O Y " printed in large block capitals was first shown to him with the remark: "Here's a word you know well" or, "I wonder if you know this word", according to the age of the child. "Now this word is spelt 'B . . O . . Y' But if I were to ask you to spell it backwards, how would you spell it?"

Thereupon the child replied: "Y . . O . . B"

"Right. . . Now, you could spell a few little words backwards for me, couldn't you? I'll spell them forwards, and then you'll spell them backwards. Well, the first word is 'Dog' - D . . O . . G" etc.,

When the word "cart" was reached, one said: "The next word is a little more difficult, because it has four letters. It is the word 'cart'".

If the child was accustomed to use the phonetic pronunciation of letters - ascertainable by the way in which the original "Y . O . B" was pronounced - this pronunciation was used by the investigator.

With regard to the numbers, the procedure was as follows:

"Now, you could do the same with numbers, couldn't you? If I say '1 . . 2 . . 3' you would say '3 . . 2 . . 1'. Do you understand?"

With younger children an actual written number of three digits was first shown and the child asked to read it backwards, as with the word "boy". There was thus no doubt in the mind of the child as to what was required. When the four-digit number was reached the child was warned that it had "four figures in it", as in the case of "cart". Except in the case of the children of class 1 in the first year, the word or number was said only once. In the case of the words, the word itself was first said and then spelt by the tester. The rate was about one letter or digit per second.

The testing was begun early in February on each occasion, but the children of class 1 were not tested until the beginning of the summer term. They had thus two full terms of school work behind them, and so were familiar with small words and with figures. The writer has before him the reading book which such children have completed by the end of the second term. It contains such sentences as:

"A robin sits on a twig"

"Winifred has a cup of milk"

There was thus no question of these younger children not being familiar with words of the size given in the test. Nevertheless, in order to counteract any disadvantage due to lack of familiarity with letters and figures on the part of this group of children, they were made to repeat each set of letters or digits forwards, several times, until it was seen that they knew them. Then they were asked to proceed with the backward repetition of the word or number in question. Even then, when the child tended simply to repeat the word or number forwards, the tester said: "No, begin with G - or 3" - as the case might be. Thus every possible assistance was given to these children of the youngest class. The following year, however, no such help was given to the children of this class, so that the difference due to this coaching might be estimated.

Generally speaking, there were two types of error - one being to forget the first digit of a series, and the other being to return to the original "forward" order. Thus in the case of "arm", "m . . r . . m" was a frequent rendering, and, for 5 . . 9 . . 6 one got "6 . . 5 . . 9".

The advantage of including both numbers and words in such a test is, that it calls out two forms of imagery control. In the case of the words the letters are less likely to be forgotten, but just because the child has been accustomed to spell these words in the normal way, he has to overcome the strong associative tendency to spell them forwards. With the numbers, on the other hand, there is no pre-established association, but here the child must grip his image very firmly, otherwise he may easily forget the first digit given him. In this way the first half of the test shows the child's power to move freely in his imagery, despite strong association, while the second part shows his power to grip and retain an image, unaided by any previous memory.

Whenever a child made a mistake, he was warned - not in such a way as to make him nervous - but so that, through mere carelessness, he should not repeat the error. When a mistake occurred, one said : "Here's another one. Be careful this time!" or "That wasn't quite right, was it? Never mind, try another one." In cases of forgetting one said "Forgotten it, never mind try another one." Sometimes in cases of forgetting, instead of remaining silent, the child invented a digit in the place of the one forgotten. In such cases the former warning was given. This warning was found to bring about a subsequent correct response on many occasions.

Immediately upon completion of this test, the test for relational thinking was given. It was necessary to devise for this purpose a test which involved the grasping of a relation, and yet the performance of which was simple enough for the youngest to understand. The following procedure was decided upon: The tester asked the child to stand facing him at a distance of about three feet, and then said : "Now I am going to move one of my feet, and I want to see if you can copy me - do just as I do;- only I want you to be very careful to watch <u>which foot I use</u>." The last four words were said slowly and with emphasis. Then the tester, remaining standing, crossed his feet, placing the right foot on the opposite side of the left foot, so that they touched.

The tendency of the younger children, of course, was to move the left foot and place it on the other side of the right, not realising the reversed relationship in which they stood to the investigator. No indication whatever was given if the child used the wrong foot, and, after telling the child to replace his foot, the investigator said: "Now I'm going to move my head, and I want you to copy me just the same." Then he inclined his head to the right. Of those children who were correct in only one of the actions, it was in the great majority of cases the "leg" action which was correct.

The number of children at each age was as follows:

Age:	5	6	7	8	9	10	Total
1st. Year:	26	47	34	31	23	--	161
2nd. Year:	25	41	48	37	32	22	205
	51	88	82	68	55	22	366

Of these, the following were actual re-tests:

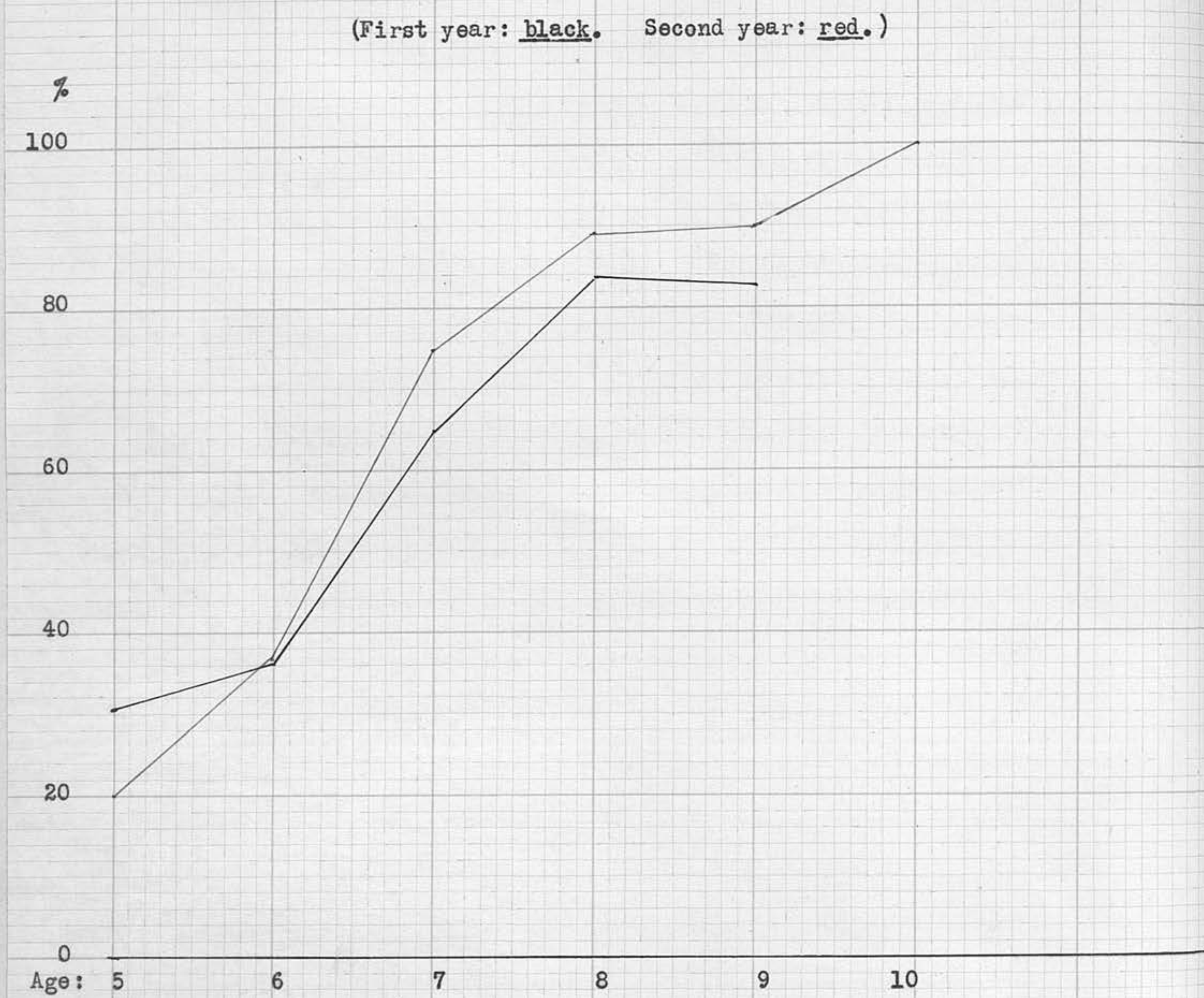
Ages:	5 & 6	6 & 7	7 & 8	8 & 9	9 & 10	Total
	25	42	29	29	19	144

The average age of each of these groups was as follows:

Age:	5	6	7	8	9	10
1st. Year:	5;8½	6;6	7;6	8;6	9;4	
2nd. Year:	5;7½	6;6	7;6	8;6	9;6	10;4

The standard deviations of these average ages were between 3¼ and 3½

FIGURE 8.



months for all but age 5 (both years), age 9 (1st. year), and age 10. These lay between 2 and 3 months.

As the ages are calculated to the nearest week, it happens that children within two days of their next birthday are considered as belonging to the following year. This, however, occurred in only four cases - three in the first year test, and one in the second.

We shall consider first the reverse digits and letters test, but excluding the large word and number since these are more difficult in degree, and will be dealt with separately later.

Allowing for one slip in each series, and therefore making a "pass" 2 out of 3 words, and 2 out of 3 numbers, the following are the results:

Age:	5	6	7	8	9	10
1st. Year:	8	17	22	26	19	--
%	30.7	36.0	64.7	83.8	82.6	
Interval:		.14	.74	.61	--	
2nd. Year:	5	15	36	33	29	22
%	20.0	36.6	75.0	89.0	90.6	100
Interval:		.50	1.02	.39	--	--
Two years combined:	13	32	58	59	48	22
%	25.5	36.4	70.7	86.8	87.3	100
Interval:		.31	.89	.56		
Progress Ratio:		-.47	+.51	-.05		

In figure 8 these percentages are expressed graphically; and it will be seen first of all how closely the two years correspond in spite of the fact that in the second graph we have mainly the same children a year older. The difference of 10% at age 5 between the first and second year is due presumably to the coaching given at this age during the first year test. That this difference is so small, and that, with the utmost efforts on the part of the tester only 30% of the first year 5-year-olds could succeed in this test, indicates how little control was possessed by children of that age over their mental imagery. Even at age 6 the proportion is no more than 36%, although in the first year there are 15 children who belonged to class 1, and so received the help given to the 5-year-olds.

It will be noted that the greatest progress is made between age 6 and 7 in each year, followed closely by the 7-8 interval in the first year* test. The following are the figures for the re-tested children:

Age:	5	6	7	8	9
1st Year	8	15	19	25	15
%	32.0	35.7	65.5	86.2	79.0

Age:	6	7	8	9	10
2nd. Year	10	31	26	26	19
%	40	73.5	89.6	89.6	100
Interval:	.22	1.00	.78		

The largest interval is again 6-7, followed by considerable progress

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* It is true that the 5-6 intervals do not represent a full year, but, when adjusted for this, they become only .18 and .57, respectively.

at 7-8. Owing to the coaching given to the youngest children in the first year, the percentages at 5 and 6 are somewhat higher in that year than they would otherwise have been, all the children of 5 having been helped, and about a third of those of 6. This means that both the 5-6 and the 6-7 intervals should be a little larger than they appear here. If we reduce the age 5 percentage to say 22%, the difference being roughly that due to coaching between the first and second year test at this age, the 5-6 interval would then be .52. Without allowing for any increase in the 6-7 interval due to the coaching factor, the difference between the two intervals is still a large one.

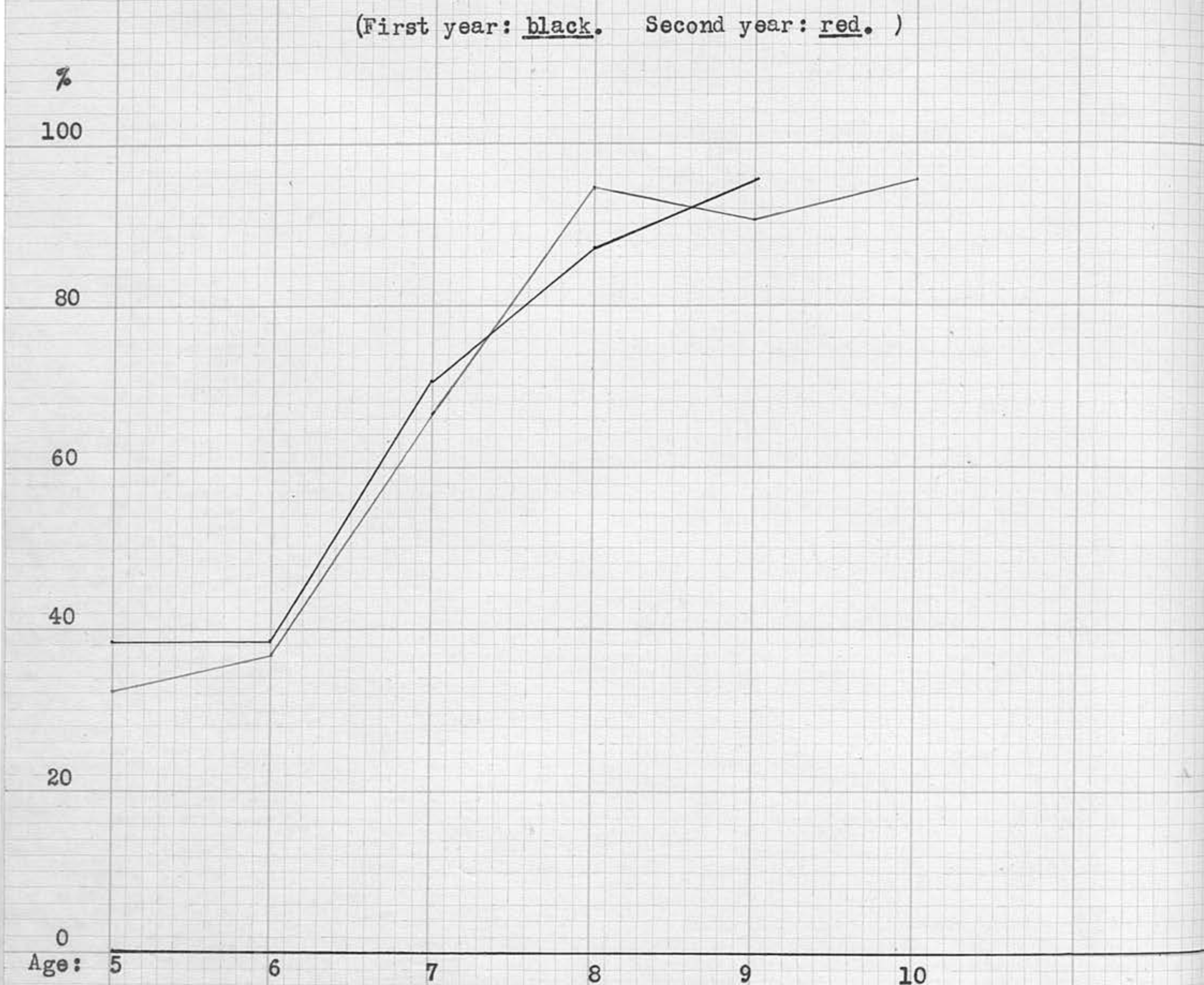
We may now summarise our results for the years 5 to 8, in respect of this type of mental operation, in the following manner:

5-6 interval greater than 6-7	6-7 interval greater than 5-6	7-8 interval greater than 5-6 or 6-7
Burt (N.)	T. & C.	Goddard
Rowe	Bobertag	
T. T. W.	Cuneo & Terman	
	Moray House (Binet)	
	Moray House (Special)	

5-6 & 6-7 equal
T. L. O.

Bearing in mind that in the case of Burt and Rowe the 6-7 interval follows closely behind the 5-6 interval in regard to size, we may say that, as between these two age-intervals, the emphasis lies more upon the year 6-7. In regard to the 7-8 interval, we do not of course know the behaviour of the Cuneo & Terman children during this year, nor do the

FIGURE 9.



Moray House (Binet) figures extend so far. But there is a tendency in Burt (M.D.) Bobertag, and the writer's own Moray House test, for a certain high rate of progress to continue through the 7-8 interval. It would appear, in short, that this developmental change takes place over a period of about two years, and that where the highest point of progress is at 5-6 it is continued through 6-7, and that where the greatest progress is at 6-7 development is continued at a slightly less high rate during 7-8. It will be noted that only in T. T. W. and T. & C. does the change seem to complete itself in one year.

If we now consider the more difficult part of the Moray House imagery test - the four-letter word and four-digit number - making the "pass" one correct out of two, we get the following results:

Age:	5		6		7		8		9		10
1st. Year:	10		18		24		27		22		--
%	38.4		38.3		70.5		87.1		95.6		
Interval:		.00		.84		.56		--			
2nd Year:	8		15		32		35		29		21
%	32.0		36.8		66.6		94.5		90.6		95.4
Interval:		.13		.77		.86		--		--	
Two years combined:	18		33		56		62		51		21
%	35.3		37.5		68.3		91.2		92.7		95.4
Interval:		.06		.80		.75		--		--	
Progress Ratio:		-.89		+.48		+.39					

The following are the figures for the re-tested children:

Age:	5	6	7	8	9
1st. Year	10	15	22	25	18
%	40.0	35.7	75.8	86.2	94.7

Age:	6	7	8	9	10
2nd Year:	8	26	27	26	18
%	32.0	61.9	93.1	89.6	94.7
Interval:	--	.67	.48		

Graphs of these results are shown in figure 9. The most notable feature of the above figures is the very slight progress made during 5-6. The coaching in the first year has brought the 5-year-olds to the level of achievement of year 6, and in the re-test has actually brought them to a higher level. It is interesting to note that, on the other hand, the actual percentage of passes at 5 is higher than in the test for smaller words and digits. This would appear to be due to the fact that while the four letters and digits test is more difficult in degree, the standard of scoring is lower (1 out of 2 as against 2 out of 3). This lower standard - especially after the practice involved by the three previously given words and numbers - enabled a certain number of children to pass, but the majority had to wait until age 7 before having the necessary mental structure. There is therefore a natural tendency for the higher rate of progress seen at 7, to be continued into the 7-8 interval which, in the case of the second year test, is actually larger than 6-7. This is just what is to be expected in a test which is slightly more difficult in degree but not in structure.

An interesting comparison with these results is found in an experiment by Mary H. Young in regard to audito-vocal digit spans (24). Children from 4;0 to 7;11 in two Philadelphia public schools (581 cases) were tested for forward repetition of digits, one out of three constituting a pass. Also, 1179 children, representing all the children of Bloomington, Indiana, public schools, between the ages of 6;0 and 10;11, were given the same test, as well as a reverse digit test.

The following were the results for a forward digit span of five or more digits:

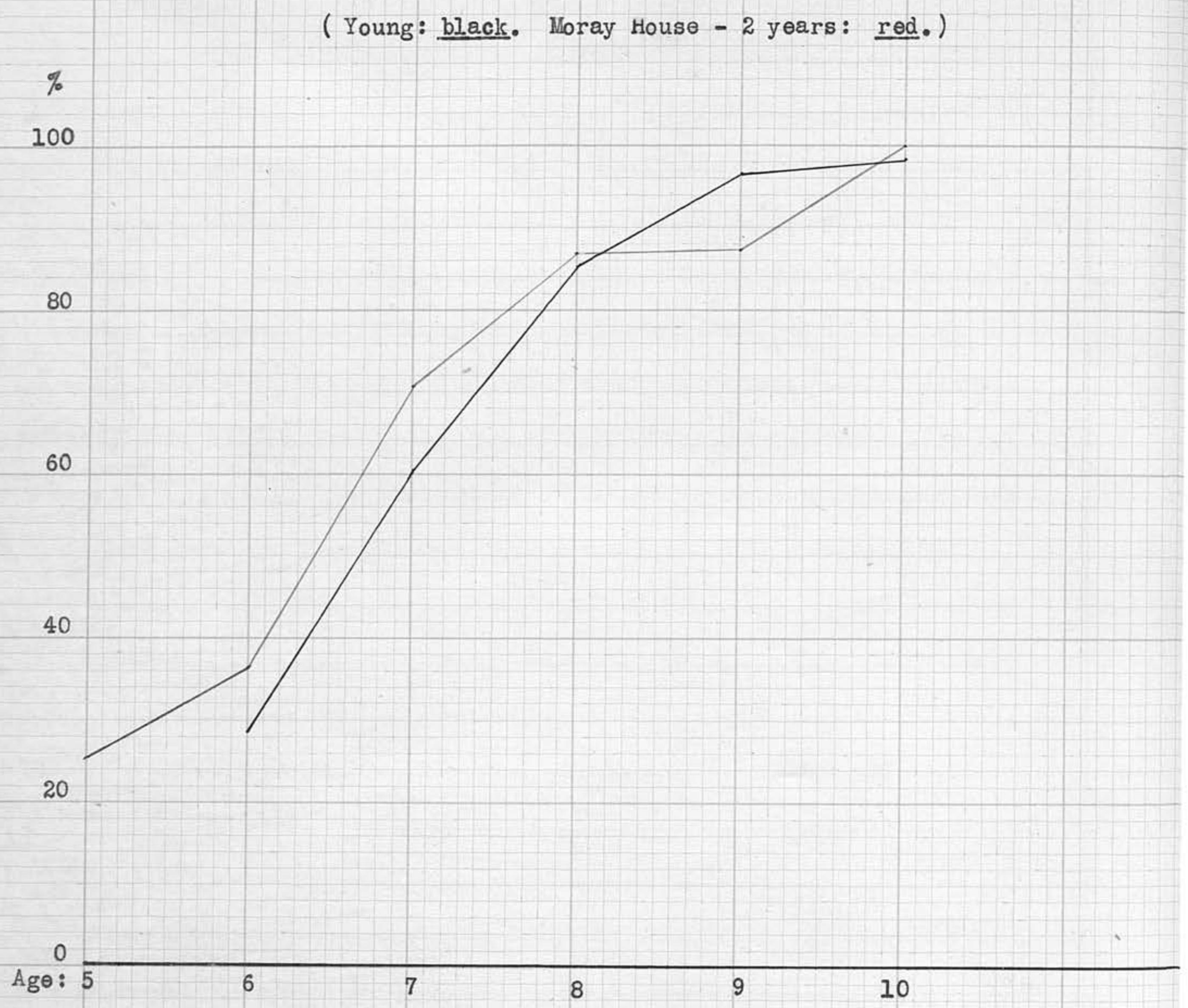
Age:	5	6	7	8	9	10
	40/118	229/394	346/467	203/251	225/245	217/232
%	33.9	58.1	74.9	80.9	91.8	93.5
Interval:	.63	.46	.20	--	--	

The results for the reverse digit span test involving three or more digits, were as follows:

Age:	5	6	7	8	9	10
		56/195	155/256	215/252	235/244	228/232
%		28.7	60.5	85.3	96.3	98.3
Interval:			.83	.78		

Both of the above tests belong to the 7-year level of the Terman-Binet scales; but the forward digit test shows its maximum progress

FIGURE 10.


(Young: black. Moray House - 2 years: red.)
%
100
80
60
40
20
0
Age: 5
6
7
8
9
10

during the 5-6 interval, reaching 58% at 6, continuing through 6-7, and falling off rapidly during 7-8, while the reverse digit test yields a large interval at 6-7 and an almost equally rapid development during 7-8. It reaches only 28% at 6, yet overtakes and passes the results of the other test by year 8.

The results of this reverse-digit test are shown graphically in figure 10, in conjunction with the graph of the Moray House experiment.

In the majority of cases, however, the 5 digits test shows most progress during the 6-7 interval, as the following figures show:

Interval:	5-6	6-7	7-8
Burt (normal)	1.02	(.50)	
Bobertag	.64	.94	(.42)
Goddard	--	1.49	.31
Rowe	(.51)	.76	.39
T. L. O.	.64	.41	.31
T. T. W.	.46	.82	.20
T. & C.	.00	.58	.06
Moray House (Binet)	.54	.81	--
Cuneo & Terman	.20	1.15	--

(The intervals in brackets are those wholly above 75% or below 25%, and were therefore not shown in the tables.)

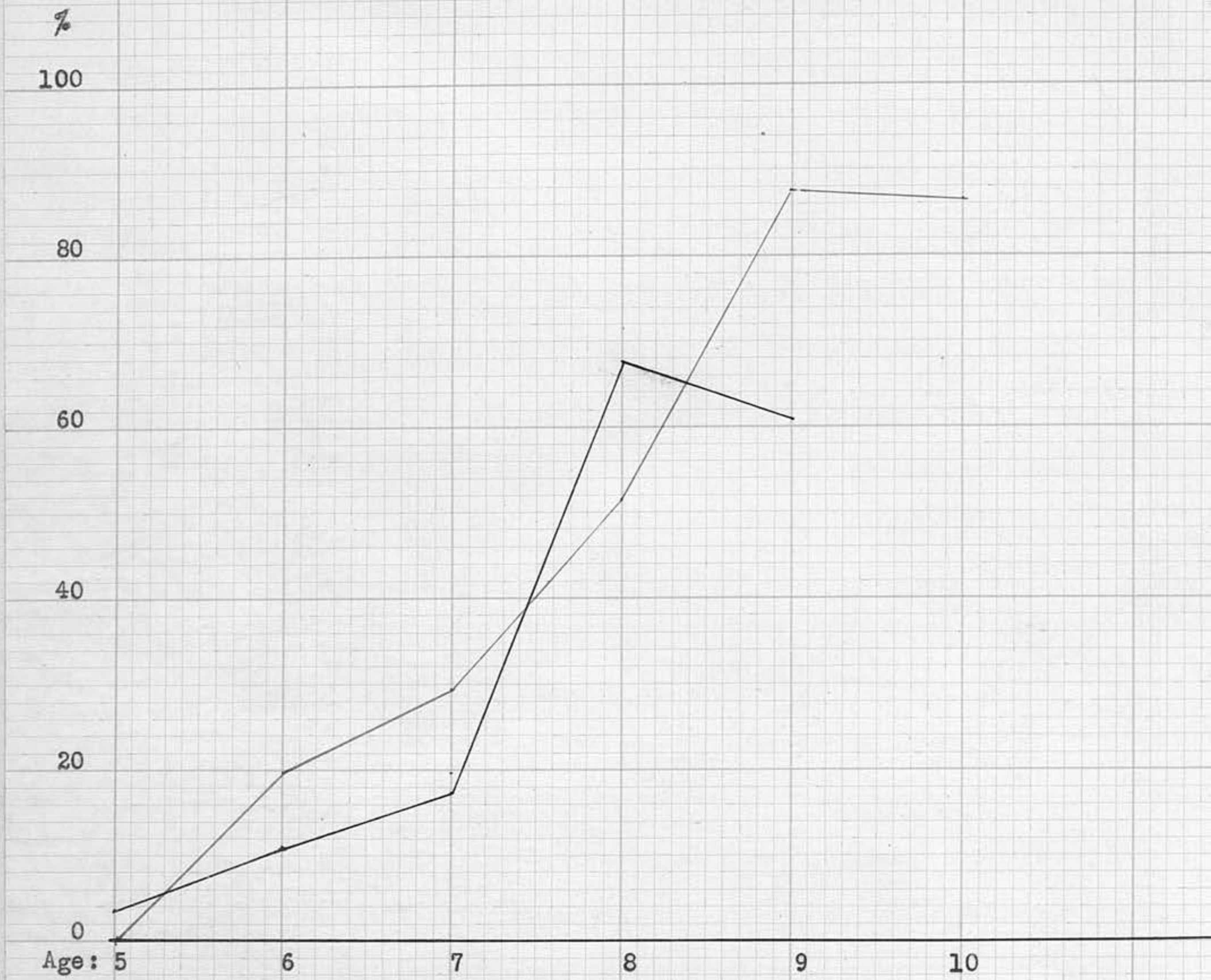
It will be seen that only Burt and T. L. O. show a larger interval at 5-6 than at 6-7.

Coming now to the Moray House test for relational thinking, the results, for both actions correct, are as follows:

Age:	5	6	7	8	9	10
1st. Year:	1	5	6	21	23	
%	3.8	10.7	17.6	67.7	60.8	
Interval:	--	--	1.39	--		

FIGURE 11.

(First year: black. Second year: red.)



Age:	5	6	7	8	9	10
2nd Year:	0	8	14	19	28	19
%	0%	19.5	29.2	51.3	87.5	86.3
Interval:		--	.31	.58	1.09	--
Two years combined:	1	13	20	40	42	19
%	2	14.8	24.4	58.8	76.4	86.3
Interval:		--	.35	.91	.50	.35
Progress Ratio:		-.3	-.34	+.72	-.06	-.34

Graphs of these percentages are shown in figure 11. It will be seen that here the principal increase is <u>after</u> year 7 - from 7 to 8 in the first case, and from 7 to 9 in the second, the largest advance in the second year test being from 8 to 9. The re-test figures are:

Age:	5	6	7	8	9
1st. Year:	1	4	5	19	12
%	4.0	9.5	17.2	65.5	63.2

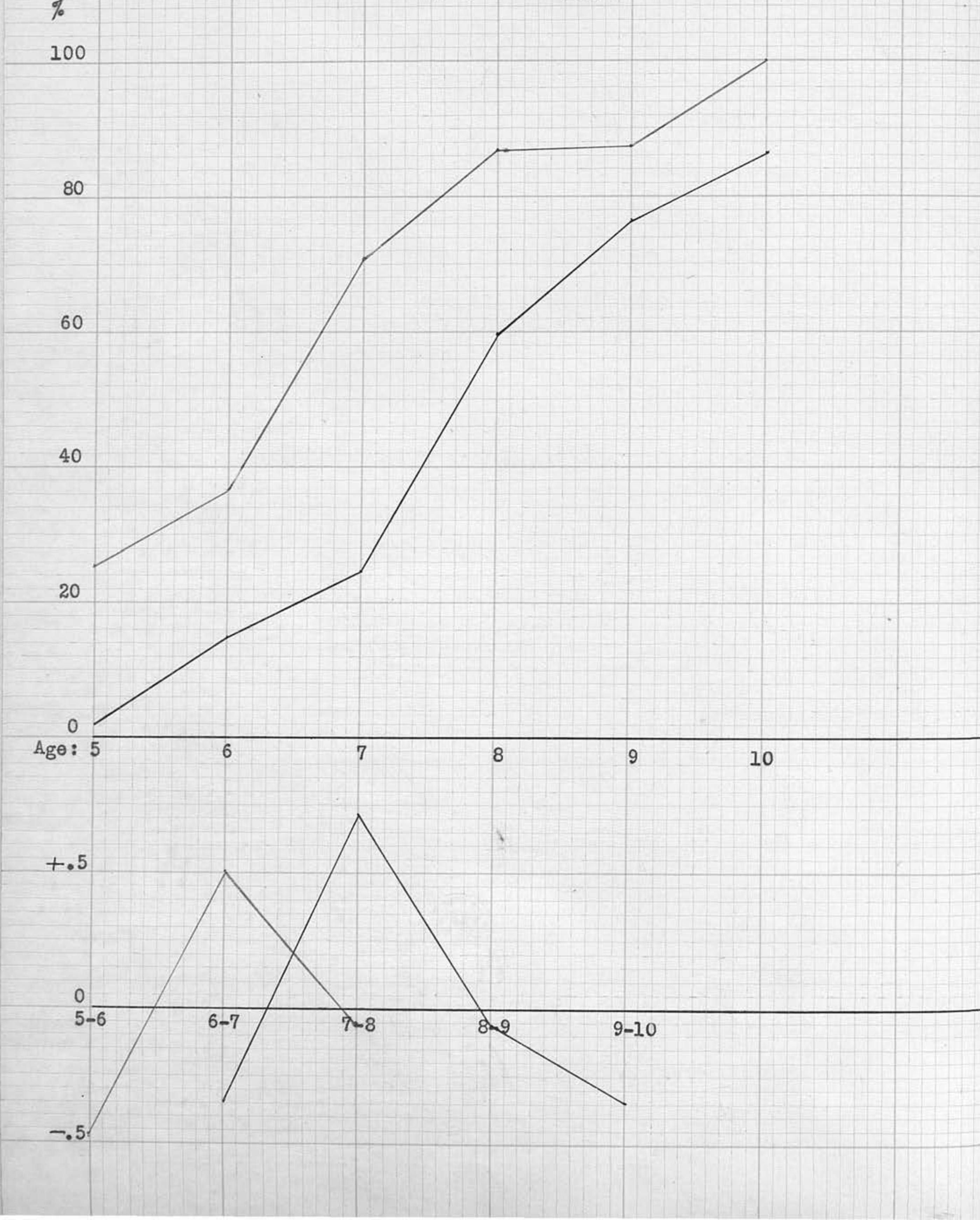
Age:	6	7	8	9	10
2nd. Year:	6	12	14	25	17
%	24.0	28.6	48.3	86.2	89.5
Interval:	.50	.61	.91	.68	.84

The emphasis in the above is upon the 7-8 and the 9-10 intervals.

Since there is nothing inherently difficult in this test - nothing in the performance of it which even the youngest child cannot grasp - it is a clear test for the emergence of relational thinking. If we now place

FIGURE 12.

(Relational test: black.
Imagery test: red.)



the two-year graph for the imagery-control test beside the combined graph for relational thinking (figure 12), we shall see the connection between the development of these two types of thinking. It will be noted than when the development of imagery-control is at its height, that of relational thought has hardly begun, and that the latter takes a leap forward just as the former is beginning to decrease in the rate of development. The same graphs, expressed in terms of "progress ratios", are also shown. These show very clearly the lack of connection between the development of the one function and of the other.

Certainly, one could not think at all without some control over imagery as a basis. For example, in this relational test, the child has to picture himself standing in the tester's place. The crux of the test is, however, not merely the ability so to picture himself, but the realisation of his <u>need</u> to do so. Relational thinking is apparently a function which begins after imagery-control has been established and which it needs as a basis for its development, but with which it is not genetically connected.

It should also be mentioned that, as the following figures show, the changes in the rate of development are most evident during the first six months of the year in which they take place. The figures below are those of the combined years of each test showing the percentages and intervals for each six months. It will be seen that the largest interval is between $6\frac{1}{2}$ and 7 in the imagery test, and between $7\frac{1}{2}$ and 8 in the relational test, - that is, the greatest change is at 7+ and 8+ respectively.

IMAGERY TEST

Age:	$5\frac{1}{2}$	6	$6\frac{1}{2}$	7	$7\frac{1}{2}$
	$\frac{10}{38}$	$\frac{13}{41}$	$\frac{19}{47}$	$\frac{26}{40}$	$\frac{32}{42}$
%	26	32	40	65	76
Interval:		.17	.22	.64	.32

RELATIONAL TEST

Age:	$5\frac{1}{2}$	6	$6\frac{1}{2}$	7	$7\frac{1}{2}$	8	$8\frac{1}{2}$	9
	$\frac{0}{38}$	$\frac{6}{41}$	$\frac{7}{47}$	$\frac{10}{40}$	$\frac{10}{42}$	$\frac{18}{33}$	$\frac{22}{35}$	$\frac{23}{33}$
%	0	15	15	25	24	55	63	70
Interval:		--	--	.37	--	.84	.20	.19

As already pointed out, the synchronisation of the Burt graph with those of the other investigators is explicable only on the assumption that the greatest change takes place during the first six months of the year-interval. The above figures seem to confirm this.

The fact that, according to seven of the ten graphs derived from the various investigators, marked progress in relational thinking is seen between 7 and 8, is further confirmed by this test. Of the three other graphs, the two French series are also found to be above the average at 7-8, but they reach a higher point at 8-9.

Viewing the Moray House experiment from the point of view of the actual percentages, it may be said that the majority of children have reached the stage of simple relational thinking by age 9. In regard to imagery-control, the majority have achieved this by age 7. In both cases the bulk of the progress covers two years - from 5 to 7 in the one, and from 7 to 9 in the other - a range from about 25% to 75%. But in each case there is a special emphasis on one of these two years, when progress is most marked, - year 6-7 in the case of imagery-control, and year 7-8 in the case of relational thinking.

There remains to be considered the increased progress in relational thinking at 9-10, as seen in Burt, Bobertag, Goddard, Rowe, Dougherty, and T. & C., and the question arises as to why T. L. O. and T.T.W. do not show this and why the 8-9 interval with them is so much greater, while, in the French data, it is the largest interval in the series.

Comparing Burt and T. L. O. at year 8-9, we find that the latter shows markedly higher intervals in respect of the following tests:

	Burt.	T. L. O.
Giving Change	.35	.56
Sentence-building	.31	.62
Absurdities	.14	.91

This is occasioned by the following percentages:

	Burt		T. L. O.	
	8	9	8	9
Giving Change	68	79	38	60
Sentence-building	34	46	44	68
Absurdities	24	29	16	47

Progress in the first test has been retarded with T. L. O. and these children achieve during 8-9 what Burt's children have already achieved by 8. In the other two tests, T. L. O. is ahead of Burt and reaches at 9 percentages which Burt does not reach until 10. (The tests for sentence-building are not quite similar. Burt allows here two sentences, but only one chance is given. Terman requires one sentence but gives three chances and allows one error.)

Comparison of Burt and T. T. W. shows the following:

	Burt.	T. T. W.
Date	.42	.60
Giving Change	.35	.86
Sentence-building	.31	.52
Absurdities	.14	.55

Here we have the same tests, together with "Date". The corresponding percentages are:

	Burt		T. T. W.	
	8	9	8	9
Date	71	84	48	71
Giving Change	68	79	29	62
Sentence-building	34	46	48	68
Absurdities	24	29	29	50

The tendencies here are the same. The first two tests show T. T. W. to be a year behind Burt, and in the remaining two Burt is a year behind T. T. W.. In other words, during 8-9 T. L. O. and T. T. W. make up some lost ground and at the same time anticipate some of the progress more normal to 9-10. We have already seen that in the second year of the Moray House test the largest interval in "relational thinking" appeared at 8-9. Something of this tendency would seem to be present in the T. L. O. and T. T. W. graphs, and serves to level up the 8-9 interval. It is due to this larger 8-9 interval, rather than to a lack of progress by year 10, that these two graphs do not show a relative increase at 9-10 as the majority of the other graphs do. In fact, the "significant" ten-year tests show percentages equal to, or greater than, those of Burt at this age.

Postponement of the 7-8 development seems to be present also in the French data, where all the 8-9 intervals are large, giving the very pronounced peak at 8-9 in both these graphs. The usual progress is not maintained at 10, however, in fully half of the tests at that age.

After imagery-control has been established at 7, further development tends to follow that of relational thinking in Bobertag and Rowe, and this tendency in these later years can also be seen in Binet and Lévistre and Morlé. In Burt a modified form of it is seen in the change in direction taken by the graph after 8-9. In Terman's three series, and in Dougherty, there is an increase at 8-9, and this would seem to be also in accordance with the development of relational thinking in respect of the larger interval found at that age. But whereas in relational thinking this served merely to smooth out the graph in T. L. O. and T. T. W., here it appears quite clearly. The relational thinking graph in T. & C. and in Dougherty is not smoothed out at this interval, but the 8-9 interval is not so low with them as in Burt, Bobertag, Rowe and Goddard.

This tendency for non-relational thinking to develop now similarly to relational thinking, although in the earlier years the two types appeared to develop on different lines, suggests that ego-development is connected in some way with relational thinking. For, once the ego is able to adopt an objective relation to imagery and to control it, all further development on these lines - as in repeating 7 digits, 26 syllables, and the like, - is a matter of the increasing strength or awakeness of the ego. On the other hand, since relational thinking and imagery-control appear to be unconnected in their first development, one of them, at least, during this first period is not connected with ego-development. Imagery control may arise through a dissociation of imagery from the motor system, and not through any activity on the part of the ego.

Increased progress in relational thinking at 10, where it occurs, is in contrast not only to the 8-9 interval but also to those which follow - (with the exception of Goddard). In "An analytical and comparative study of the Binet-Simon test responses of 1306 Philadelphia school children" (25), the author (Arthur Philips) remarks upon this ten-year level. He has examined children of the 3rd, 5th, and 6th "grade" only, the average ages of whom are 8, 10, and 11 respectively, and the percentages of passes for the individual tests are given. But, unfortunately, the 9-year-olds not having been tested, we cannot make use of the data for a serial graph, The author, however, notes a very substantial increase in the number of passes between 8 and 10, compared with those between 10 and 11, even allowing for the difference in the interval and for the fact that the average I. Q. of the 11-year-olds is rather lower than that of the 10-year children. He remarks as follows: (p. 34)

> "The impressive fact that emerges in comparing the percentage of gain in the passes of the 5th grade over the 3rd grade, and of the 6th grade over the 5th is the enormous gain in ability to pass the tests in the two year interval between the 3rd and 5th grades, and the meagre gain in the one year interval between the 5th and 6th grades." . . . .
>
> (p. 35) "It is doubtful, however, whether the large gain in the two year interval over the one year interval is to be attributed entirely to the fact that the 6th grade is inferior to the 5th. There is room for the opinion that sometime between 8 and 10 years or between the 3rd and 5th grades the child makes such rapid growth intellectually that the ten year level might be called the intellectual level."

The following are Philips' figures for those "relational" tests which are less than 75% at year 8, showing the progress through 10 and 11, with standard deviation intervals:

Age:	8		10		11
Absurdities	30.9	2.00	95.5	--	93.1
Comprehension (4)	26.5	1.39	77.5	.16	82.0
Fables (4)	12.3	1.42	60.9	.29	71.7
Picture Interp.	11.5	1.12	48.0	.34	61.5
Mixed Sentences	4.4	1.53	53.8	.50	72.6
Similarities (3)	4.4	1.32	46.8	.31	58.9
Average Interval:		1.46		.32	

As will be seen, the average interval for the years 8-10 is more than four times that of 10-11. As we do not know the nature of the 8-9 interval here, we cannot say how much is attributable to year 10: but the relatively low rate of progress during the year 10-11 is clear in the case of each test.

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The third aspect of mental development, that of non-relational thinking connected with the immediate environment, needs little comment. The data for Burt (normal), Rowe, T. L. O., T. T. W., T. & C., Bobertag, Goddard, Dougherty, and Lévistre and Morlé, are shown in tables 28 - 36 and graphically in figure 13. In this figure the graphs are shown in conjunction with those of simple thinking not connected with the environment. The last four series are incomplete. Binet has no intervals in this series. The figures and graph for Burt's M. D. children have already been given in table 8 and figure 1, but the graph is shown again here. Tables 37 and 38 give the relevant figures for the Moray House (Binet) and Cuneo and Terman data.

It will be seen that there is a general tendency for these new graphs to follow those of thinking unconnected with the environment, especially in the earlier years. This is borne out by the Moray House and Cuneo and Terman results. This tendency is understandable when we consider that thinking connected with the immediate environment depends at first for its accuracy upon the ability to apprehend the environment as it is, and the keeping aside of all possible intruding ideas or images in the light of which the environment might be erroneously apprehended. In other words, it involves primarily the ability on the part of the child to free himself from his ideas and images, and which is the prelude to a control and objectification of them. It is for this reason that the child does not correctly observe the facts before him in the "missing feature" test until he has reached an age at which he ceases to read into the environment what he expects to find there.

The quantitative analysis of Binet test data appears therefore to agree very closely with the qualitative changes to be observed in the scale itself in its most recent forms. Where there is a qualitative change, a quantitative increase in the rate of development appears. The rate of development of imagery-control is found most consistently to reach its highest point about the age of 7, where this quality of test first clearly makes its appearance in the scales. Relational thinking which, according to the most recent scale, is present at 7, is seen, however, to develop qualtitatively most rapidly between 7 and 8 in the majority of cases, and in this respect the original Terman revision agrees exactly, showing at the same time the succeeding hiatus between 8 and 9 (table 1). The qualitative change at 10, involving relational thinking on a higher level, is also seen in a quantitative increase where this is not blurred by a late development of the previous change. After age 10 there is a gradual increase in the abstractness of the ideas which can be objectified and no sudden qualitative change. This can also be seen in the graphs, all of which, except Goddard, remain below the average line during these two following years.

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F I G U R E 13. (Cont.)

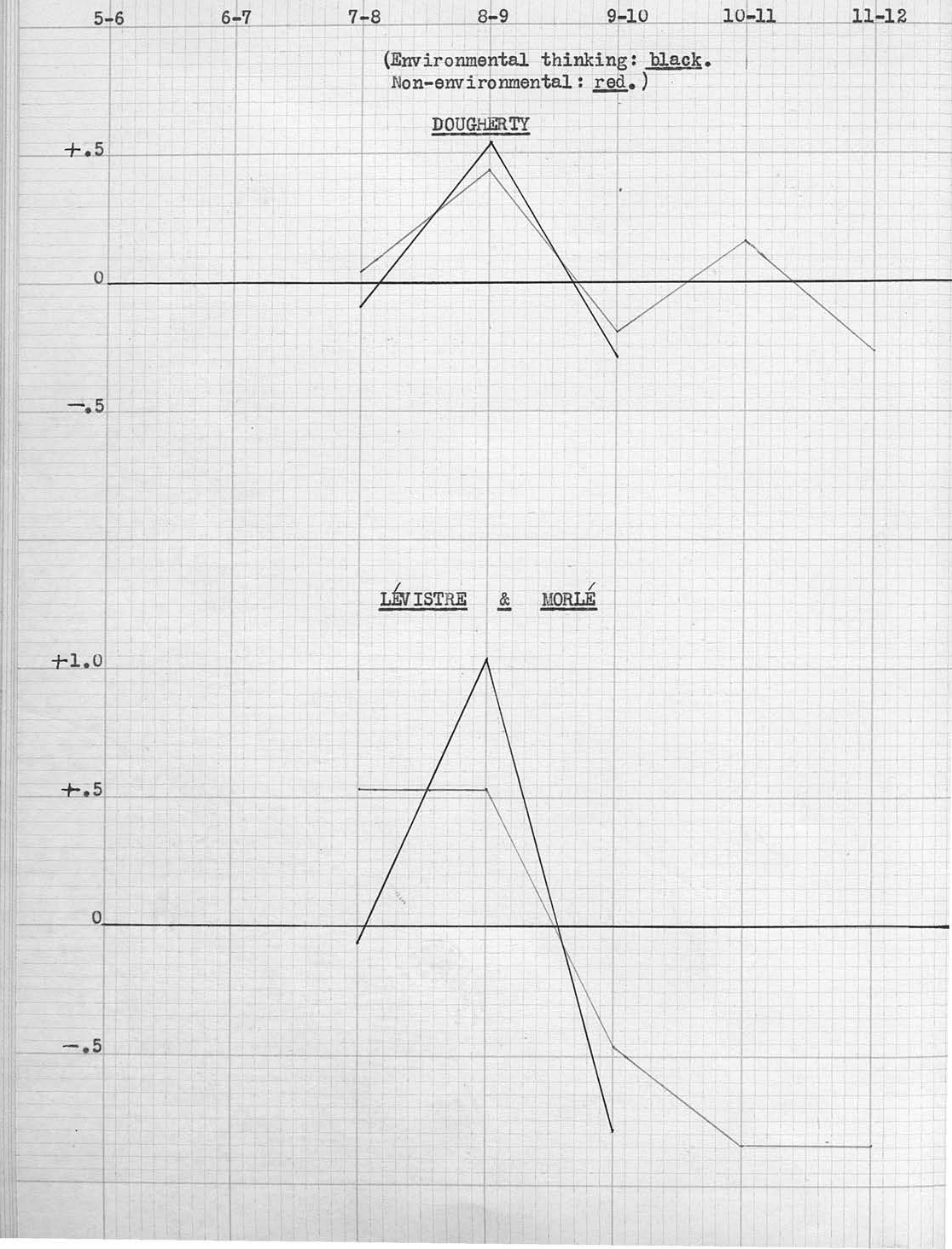
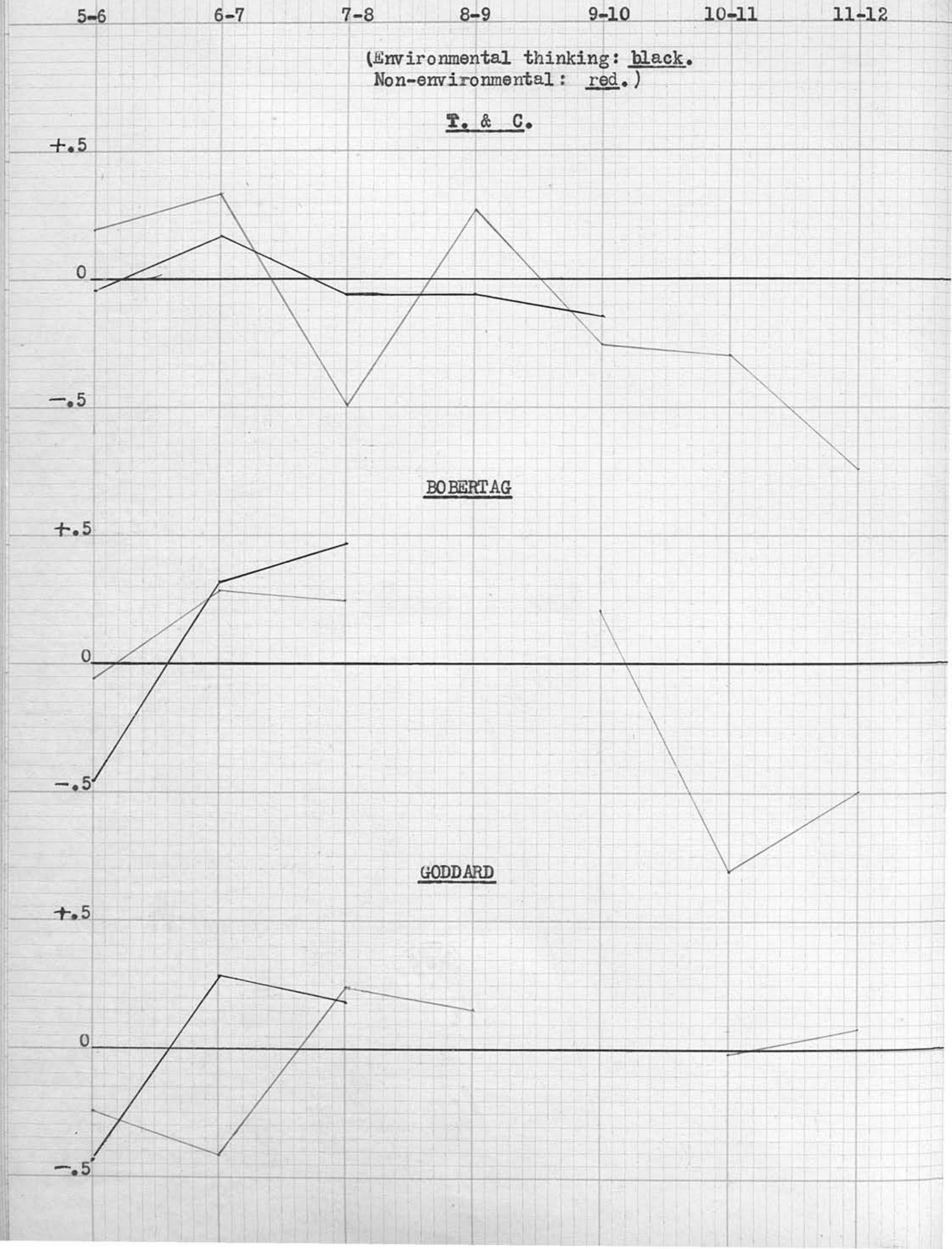


FIGURE 13. (Cont.)



F I G U R E 13. (Cont.)

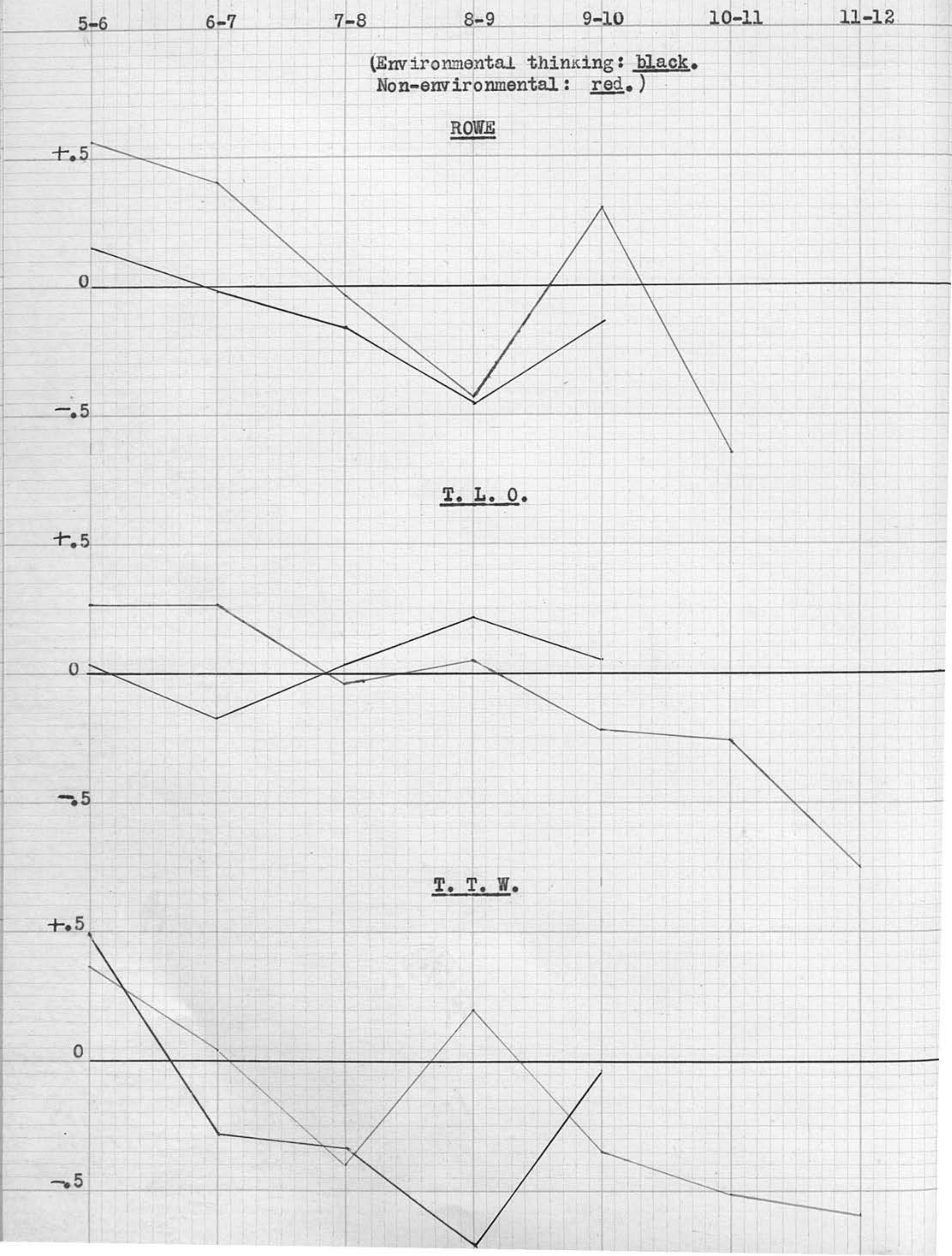


FIGURE 13.

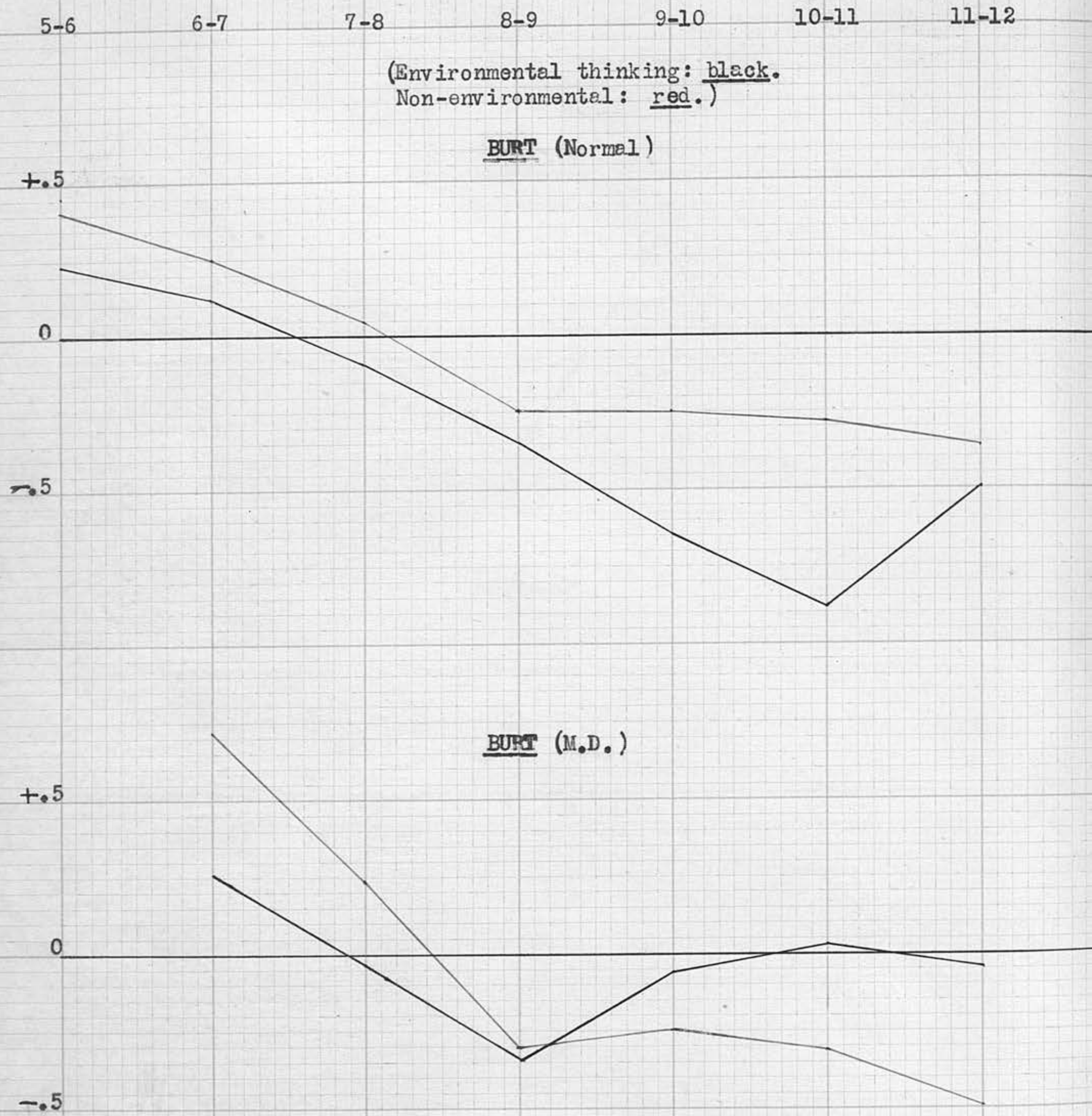

5-6
6-7
7-8
8-9
9-10
10-11
11-12
(Environmental thinking: black.
Non-environmental: red.)
BURT (Normal)
+.5
0
-.5
BURT (M.D.)
+.5
0
-.5

TABLE 28.

BURT

(London Children.)

NON-RELATIONAL THINKING.
(connected with environment)

Age:	5		6		7		8		9
2 Weights	68.3	.58	85.8	--	92.2	--	96.4	--	99.1
Fingers	62.5	.77	86.6	--	95.3	--	98.6	--	99.3
13 Pennies	51.6	1.03	85.8	--	96.6	--	99.0	--	100.
Diamond	49.8	1.04	83.8	--	95.6	--	97.6	--	98.3
4 Coins	48.8	.98	82.8	--	94.0	--	97.2	--	97.6
Divided Card	47.2	.94	80.8	--	86.2	--	92.2	--	96.0
Picture Descript.	49.8	.68	73.5	.40	84.7	--	93.6	--	96.8
Right & Left	52.0	.65	75.7	--	83.8	--	90.1	--	97.1
Pence & Halfpence	18.9	.65	41.8	1.09	80.5	--	90.4	--	96.8
Missing Features	34.0	.80	65.3	.72	87.3	--	95.6	--	98.6
9 Coins	1.3	--	9.9	.76	33.3	.61	57.2	.53	76.0
Suggestion	1.3	--	5.3	--	6.9	--	23.6	.23	31.4
Average Interval:		.81		.74		.61		.43	
PROGRESS RATIO:		+.23		+.12		-.09		-.35	

Age:	9		10		11		12
9 Coins	76.0	--	85.8	--	95.4	--	97.7
Suggestion	31.4	.24	40.1	.08	43.1	.33	56.2
Average Interval:		.24		.08		.33	
Progress Ratio:		-.64		-.88		-.50	

TABLE 29.

ROWE

(Michigan Children.)

NON-RELATIONAL THINKING
(connected with environment)

Age	5		6		7		8		9
Right & Left	56	1.00	88	--	91				
Picture Descr.	65	.75	88	--	97	--	98	--	98
Missing Features	55	.48	73	.64	95	--	93	--	98
Diamond	67	.60	85	--	88	--	91	--	100
4 Colours	38	.92	73	.57	91	--	96	--	98
Stamps	18	.79	45	.74	73	.61	93	--	82
9 Coins		--		--	40	.50	60	.36	73
Average Interval:		.756		.65		.555		.36	
PROGRESS RATIO:		+.15		-.02		-.16		-.45	

Age:	9		10		11
9 Coins	73	.57	91		
Average Interval:		.57			
Progress Ratio:		-.14			

T A B L E 30.

<u>T E R M A N, L Y M A N, O R D H A L</u>

(Californian Children)

NON-RELATIONAL THINKING
(connected with environment)

Age:	5		6		7		8		9
2 Weights	70	.74	94	--	96				
4 Colours	74	.43	86	--	97				
Aesthetic Compar.	73	.62	94	--	96				
Divided Card	70	.70	92	--	95				
Right & Left	50	.55	71	.52	86	--	95		
Missing Features	50	.39	65	.72	87	--	96		
13 Pennies	46	.81	76	--	93	--	96		
4 Coins	47	.72	74	.53	91	--	95		
Fingers	24	.74	51	.55	72	.49	86	--	95
Picture Descript.	27	.76	56	.18	63	.81	88	--	97
Diamond	4	.77	30	.88	64	.59	83	--	94
6 Coins		--	27	.36	40	.61	64	.78	88
Stamps		--		--	13	.83	39	.78	69
Average Interval:		.657		.53		.666		.78	
Progress Ratio:		+.03		-.17		+.04		+.22	

Age:	9		10		11		12
6 Coins	88	--	95				
Stamps	69	.68	90	--	96	--	97
Average Interval:		.68					
Progress Ratio:		+.06					

TABLE 31.

TERMAN, TROST & WADDLE.

(Californian Children)

NON-RELATIONAL THINKING
(connected with environment)

Age:	5		6		7		8		9
Missing Features	33	1.08	74	.43	86	--	97		
13 Pennies	25	1.11	67	.80	92	--	94		
4 Coins	25	1.55	81	--	95	--	98		
Fingers	25	.85	57	.66	80	--	88	--	98
Picture Descript.	23	1.15	66	.33	77	--	95	--	100
Diamond	10	1.17	48	.57	70	.40	82	--	91
Stamps		--		--	26	.64	50	.23	59
Average Interval:		1.15		.558		.52		.23	
Progress Ratio:		+.48		-.28		-.33		-.71	

Age:	9		10		11		12
Stamps	59	.76	84	--	91	--	100
Average Interval:		.76					
Progress Ratio:		-.03					

T A B L E 32.

<u>T E R M A N</u> & <u>C H I L D S</u>.

(Californian Children)

<u>NON-RELATIONAL THINKING</u>
(connected with environment)

Age:	5		6		7		8		9
4 Colours	74	.35	84	--	96				
Right & Left	73	(.06)	75	--	90	--	93		
Missing Features	48	.23	57	.29	68	.45	82		
13 Pennies	55	.51	74	.66	100	--	100		
4 Coins	41	.73	69	.74	93	--	100		
Fingers	33	(1.05)	73	.59	92	--	97	--	100
Picture Descript.	42	.28	47	(.17)	60	.27	70	.43	83
Diamond	16	.79	42	.64	67	(.75)	90	--	98
6 Coins		--	0	(1.00)	33	.69	60	.63	81
Stamps		--		--	58	(.05)	60	.36	73
<u>Average Interval</u>:		.48		.58		.47		.47	
<u>Progress Ratio</u>:		-.<u>04</u>		+.<u>17</u>		-.<u>06</u>		-.<u>06</u>	

Age:	9		10		11		12
6 Coins	81	--	90				
Stamps	73	.43	85	--	90	--	100
<u>Average Interval</u>:		.43					
<u>Progress Ratio</u>:		-.<u>14</u>					

NOTE: The percentages used are taken from "The Stanford Revision of the Binet-Simon Scale".

TABLE 33.

BOBERTAG.

(Breslau Children.)

NON-RELATIONAL THINKING.
(connected with environment)

Age:	5		6		7		8	9
Divided Card	30	(.94)	66					
Right & Left	45	.21	53	.56	74			
Missing Features	30	.25	39	1.02	77			
Aesthetic Compar.	50	.68	75					
4 Colours	35	.34	48	(.23)	57	1.00	89	
Fingers		--	51	1.27	93			
Diamond		--	32	.75	61			
Average Interval:		.37		.90		1.00		
Progress Ratio:		-.46		+.32		+.47		

TABLE 34

GODDARD

(New Jersey Children)

NON-RELATIONAL THINKING
(connected with environment)

Age:	5		6		7		8	9
Copying Square	67.6	.68	88.0	--	100			
Divided Card	62.5	.31	73.7					
Right & Left	68.2	.42	81.4	--	88.2			
Aesthetic Compar.	56.0	.61	77.5	--	94.1			
Missing Features		--	63.1	.87	90.6	--	91.9	
Fingers		--	37.5	1.76	95.0	--	100	
Diamond		--	43.6	1.47	92.2	--	92.3	
Picture Descript.		--	48.6	.76	76.8	--	93.2	
13 Pennies		--	72.7	.64	94.9	--	97.1	
4 Coins		--	33.3	1.43	84.1	--	92.8	
Stamps		--		--	48.4	1.07	84.9	100
Average Interval:		.505		1.155		1.07		
Progress Ratio:		-.44		+.28		+.19		

NOTE: There is one interval at 9-10: 9 Coins: 68.8% .80 95.5%

T A B L E 35.

D O U G H E R T Y.

(Kansas Children)

NON-RELATIONAL THINKING
(connected with environment)

Age:	5		6		7		8		9
Copying Diamond					71.6	.66	93.5		
Counting Stamps					40.3	.95	75.8	--	94.8
9 Coins					16.4	.47	30.6	1.16	74.1
Average Interval:						-.69		1.16	
Progress Ratio:						-.09		+.53	

Age:	9		10	11	12
9 Coins	74.1	.54	91.8		
Average Interval:		.54			
Progress Ratio:		-.29			

T A B L E 36.

L É V I S T R E & M O R L É

(Parisian Children)

NON-RELATIONAL THINKING
(connected with environment)

Age:	7		8		9		10
Missing Features	30	1.36	80				
Picture Cescript.	70	.86	100				
4 Colours	40	1.48	90				
Pence & Halfpence	40	1.48	90				
9 Coins		--	20	2.80	100		
Suggestion		--		--	20	.31	30
Average Interval:		1.295		2.80		.31	
Progress Ratio:		-.06		+1.03		-.78	

T A B L E 37.

C U N E O & T E R M A N

(Californian Children)

NON-RELATIONAL THINKING
(connected with environment)

Age:	5		6		7
2 Weights	52	.56	73	.71	100
4 Colours	65	.22	73	.65	96
Aesthetic Compar.	71	.19	77	--	96
Divided Card	60	.36	73	.49	87
Right & Left	46	.71	73	.49	87
Missing Features	35	.67	61	.83	87
4 Coins	38	.62	62	.80	87
Fingers	8	.73	31	1.02	70
Picture Descript.	29	.91	64	.59	83
Diamond	8	.70	30	1.29	78
6 Coins	2	--	2	.63	26
13 Pennies	44	.38	59	1.33	100
Average Interval:		.55		.80	

TABLE 38.

MORAY HOUSE CHILDREN

NON-RELATIONAL THINKING
(connected with environment)

Age:	5		6		7
Fingers	39.1	.83	70.9	.76	97.7
Diamond	17.2	.95	50.0	1.41	95.5
4 Coins	72.5	.37	83.4		
Missing Features	72.1	.59	91.7		
Picture Descript.	53.8	.33	66.6	.72	88.6
13 Pennies	62.2	(1.05)	95.9		
Divided Card	51.4	.28	62.5	1.18	100
Right & Left	59.0	.44	75.0		
4 Colours	72.1	.38	83.3		
Average Interval:		.52		.81 (reduced by 1/5)	

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PART 4.

SOME PSYCHOLOGICAL CONCLUSIONS.

We can now see that our conclusions are substantially in agreement with those of Piaget (1 and 2); for, whenever thought remains unobjectified, the phenomena of ego-centrism and pre-causality will tend to arise. Ego-centrism, in fact, may be defined as the result of the lack of dissociation of the ego from its thoughts. Thus, until the age at which ideas can be fully objectified, namely at 7, and relational thinking reaches a certain degree of development, namely at 8, thought will tend to be ego-centric and pre-causal. Up to that time the child has, it is true, thoughts or ideas, but he tends to "live in" them; he is more or less subjectively tied to them. On this account it will be difficult for him to see things from any point of view but his own; for only when one can picture a situation and its relationships objectively, can one place oneself in the position of another person.

Further, ego-centrism will tend to appear on any level of thought the corresponding ideas of which are not yet objectified; and therefore after the changes at 7 and 8, ego-centrism will, on our analysis, be transferred to the abstract realm and to that of relations between complex ideas, since abstract ideas are not objectified until 11 or 12, and the latter not until 10. This is what Piaget found. In his chapter on Verbal Understanding (1) he describes the application of a test of proverb interpretation to children of age 9 to 11. In this test a number of proverbs together with sentences expressing the same ideas (but arranged in no particular order) are presented to the child whose task is to select the sentence appropriate to each proverb; and it was found that children of these ages fail to respond correctly owing to "syncretism" of reasoning - even when each separate sentence is at least literally understood. This test involves, primarily, the cognition of two complex ideas in relation, an ability not normally present until 10, and the abstraction and objectification of an ethical rule, which does not appear until 12 (Table 2). Hence it is understandable that these children were obliged to fall back upon syncretic thought - i.e. non-analytical, because non-objectified, thought.

But this repetition of ego-centrism on the level of pure thought when it exists no longer on the plane of concrete reality, need not be explained, as Piaget appears to think, as the outcome of the child having a new task to tackle - of his having to serve a new apprenticeship on this higher level, relearning on this plane what he had previously learned on the other. It appears, on the contrary, to be simply a question of what the child can, or can not, objectify at any given stage. It is a question of how far the ego is able to detach itself from its mental surroundings. If the child can cognise an object, as such, at 6, and can use the category of Whole and Part in connection with that object, and yet cannot use this same category in the sphere of ideas, it is not because he has not yet learned or practised this function, but it is due to the fact that at this age he is not yet able properly to objectify ideas. After all, one must first be able to perceive an object before one can begin to think about it; and if a child of six is not yet able to bring ideas into mental focus, we can hardly expect his thinking about ideas to be clear or logical. Similarly, a child of 8 or 9 who can objectify concrete ideas and apprehend them in terms of relations, will be lost when asked to apprehend a relation between two abstract ideas. It is not that he needs to relearn how to see the abstract ideas in relational terms. He does not yet see the abstract ideas.

Piaget, however, appears to regard ego-centrism as something fundamental - as a pre-socialised state of mind which alters with the need for socialisation. Apart from the fact that this would hardly explain how this change comes about at a definite chronological age, instead of varying with each child's individual environment, we are in danger of viewing the data too much in the light of a theory. If we refrain from theorising and content ourselves simply with characterising the events, we observe that certain changes take place at certain ages, and that these consist, after age 7, of the progressive objectification by the ego of the various grades of ideas and their relationship. Given these changes, it is then easy to understand how progressive socialisation becomes possible; and we can see that ego-centrism can be the result simply of the ego's relationship to mental occurrences - to its living in the ideas and its consequent inability to treat them as objects.

Piaget, of course, would not deny this. Speaking of autistic thought (2) (p.11) he says: " . . . it is because it is not detached from the ego that this sort of thinking does not know itself". The present writer's contention is, however, that it is better not to assume that the change is brought about by environmental demands, but, since it is a change apparently closely associated with chronological age, to regard it simply as a stage in growth, like that of adolescence and the mental changes which accompany that.

In the same way it is not necessary to explain imitation in a child as being due to a confusion between himself and others. In this connection Piaget remarks (2) (p. 179):

> ". . . in virtue of his very ego-centrism the child is not conscious of his own thought, he has not the feeling of his own ego; consequently, he is always imitating things and people, owing to that sort of confusion between self and others which Janet made the characteristic feature of imitation."

It is true that awakeness to one's own ego and awareness of one's thoughts develop mutually; but it does not follow that a child imitates because his ego-feeling is weak. A child imitates because he does not yet think. To think, thoughts must be under the control of the ego. At the imitative stage they are not yet under this control, and therefore they act directly upon the motor system.* As the ego gains control over ideas and imagery, it inhibits this tendency and retains the thoughts for its own purposes. The thoughts then tend less to pass out into action and more to retain a mental life of their own; and thus phantasy arises. But a child can "lose" himself just as much in his own phantasy as he can in imitation. It is not a question of self-feeling in either case, but of the different relationships between the ego and its ideas.

Apart from such questions of theory, however, the fact remains that we find Piaget's conclusions to be implicit qualitatively in the Terman-Binet scales, and quantitatively in Binet test-data drawn from the most widely differing environments.

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* The term Imitation is of course used here in the restricted sense already outlined in Part 1, and does not include purposive imitative activities which, being mediated by thought of a conscious kind, are under the control of the ego.

But we have still to deal with the remainder of Mrs. Isaacs' records of "Discovery, Reasoning and Thought" (chapter 4) namely, sections 1, 3 and 4, entitled: Applications of Knowledge", "Social Interchange of Knowledge", and "Miscellaneous", as well as the chapter on "Biological Interests", viewed from the aspect of thought processes.

In these, Mrs. Isaacs claims, we have evidence which contradicts Piaget's findings to the effect that thinking in children below 7 is pre-causal and ego-centric. She holds that while ego-centric thought does appear in these earlier years, it is accompanied by objective rational thinking, and that there is no abrupt change from one stage to another.

The mental ratios of her children, however, range from 114 to 166, with a mean ratio of 131, and Piaget, in his reply to this contention (26) points out that the average <u>mental</u> age of her children is nevertheless 7. The question remains, then: do these changes which we have examined both in the Binet scales and in the various percentage-series, represent chronological age only when we have to do with the average, or "at age", child, and do children above the average in mentality develop in a different way, the changes coming earlier and more gradually?

We shall gain better insight into this question if we analyse the records which Mrs. Isaacs gives in the remaining sections of this chapter. If we extract every instance where the correct (non-egocentric) use of the word "because" has been used spontaneously by a child under the age of 7 (and not dragged out of him by adult questionings), all remarks involving explanations dealing with physical causality, and all deductions and inferences, by children under that age, we should be able to judge the validity of Mrs. Isaacs' claim.

The relevant extracts are as follows: (Commencing on page 111 and proceeding through the sections already named)

"APPLICATIONS OF KNOWLEDGE"

"BECAUSE"

Sub-Section		Date	Name	Age
A.1.		8.7.25	Dan	4;1
		13.5.26	Dexter	4;10
	*	18.3.27	Phineas	4;0
A.2.		19.10.25	Dan	4;5
	*	19.10.25	Frank	5;11
		22.6.26	Dan	5;1
		3.2.27	Dan	5;8
B.		3.12.25	Priscilla	6;4

DEDUCTION AND INFERENCE

Sub-Section	Date	Name	Age	
A.2.	16.10.24	Christopher	4;1	
	22. 6.25	Dan	4;1	
	9. 3.26	Priscilla	6;6	Ø
	26. 4.26	Christopher	5;8	
	18. 5.26	Christopher	5;9	
	24.10.26	Dan	5;5	
	16.11.26	Jessica	4;1	

PHYSICAL CAUSALITY

Sub-Section	Date	Name	Age
B.	4. 3.27	Dan	5;9

"SOCIALL INTERCHANGE OF KNOWLEDGE"

"BECAUSE"

Sub-Section		Date	Name	Age
A.		13. 2.25	Christopher	4;5
		20. 2.25	Tommy	3;0
		24. 3.25	Harold	5;2
		8. 3.26	Tommy	4;1
	*	11. 5.26	Dan	4;11
B.		2. 2.26	Frank	6;3
	*	23.11.26	Dan	5;6

DEDUCTION AND INFERENCE

Sub-Section	Date	Name	Age
A.	31.10.24	Dan	3;5
	23. 4.25	Frank	5;6
	1. 5.27	James	5;1
	13. 5.27	Lena	4;5
	-. 7.27	Dan	6;1
	1.10.27	Denis	3;10
B.	3. 3.25	Paul	4;0

PHYSICAL CAUSALITY

Sub-Section	Date	Name	Age
B.	3. 2.25	Christopher	4;5
	-. 6.27	Dan	6;1

Ø On 3.2.27 Priscilla is again quoted as being 6;6. This, of course, is a misprint for 7;6.

* Also classifiable under Physical Causality.

"MISCELLANEOUS"

"BECAUSE"			PHYSICAL CAUSALITY		
-.6.27	James	5;3	10.6.25	Frank	5;8
			10.6.25	Dan	4;1

In addition to the above, there are a few instances in Section 2 ("Increase of Knowledge: Problems and Experiment") which are not included in these other sections. These are:

	Page	"BECAUSE"			Page	DEDUCTION & INFERENCE		
*	139	17.2.27	Phineas	4;0	129	1.2.26	Dan	4;8
*	141	25.2.27	Phineas	4;0	134	1.11.26	Dan	5;5
					134	15.11.26	Dan	5;6
					135	2.12.26	Phineas	3;9
					140	22.2.27	Phineas	4;0

The following have not been included, because they appear to have been dragged out of the child by adult questions and therefore do not represent spontaneous expression:

> P. 139. "17.2.27. Phineas: 4;0. . . . Later on, when he had matches in the tube, he lit the burner at the bottom only, and this made the matches smoulder. After doing this several times, he asked, "Why does it smoke?" Miss C. said "Why?" He replied, "Because there are matches." At a later point when he had taken the matches out, and thought he had quite emptied the tube, he had left one inside unintentionally. The tube smoked, and he asked, "Why is it smoking?" Miss C. returned the question, and he replied, "There must be a match inside.""
>
> "24.2.27 Phineas (4;0) held the flame of the Bunsen in some water, and then put it right in. When the flame went out he asked, "Why did it go out?" Miss C. "Why?" Phineas - "Because of the water.""
>
> "25.2.27. Phineas (4;0) held some wet raffia in the fire, and asked: "Why won't it burn?" Miss C. - "Why won't it?" Phineas - "Because it's wet." He held it against the flame for some time, and when it began to burn he said, "It's burning now." Miss C. - "Why is it burning now?" Phineas - "Because it's dry." "What made it dry?" "The flame," he replied.

Similar incidents occurred on 22.2.27 and 21.3.27 with the same child. On the other hand, Phineas was questioned in this way on 18.3.27 (Sect. A.1.):

> "Phineas (4;0) was blowing through a rubber tube in water, and watching the bubbles rise and break. Miss C. asked, "What's making the bubbles?" He said "The wind in here" (pointing to the tube). "Where does the wind come from?" "From my mouth, because I'm blowing."

This "because" has been included in our list, since it appears to be a gratuitous response by the child although ultimately the outcome of questioning. The phrase "from my mouth" would have been an adequate reply to the question.

In Chapter 5 (Biological Interests) there are fewer instances, most of the records here relating, naturally, to practical activities. Those to be found, however, are:

Page		"BECAUSE"		Page		DEDUCTION & INFERENCE	
174	8. 3.27	Lena	4;3	172	19. 3.25	Frank	5;4
200	8. 5.27	James	5;1	188	8. 7.26	Dan	5;1
				188	9. 7.26	Priscilla	6;10
				193	15.11.26	Dan	5;5

The above classifications are not intended to be rigid. Some six of the "Becauses", in fact, might also be classified under physical causality, while some of the inferences also have implied causality. We shall therefore consider the instances as a whole.

There appear to be 27 children mentioned in Mrs. Isaacs' records; and their names, arranged according to the school session in which they first appear, are given below. Opposite each name is shown the number of times the child appears in the above tables as having spontaneously expressed one of these three types of thought, and the number of sessions or part-sessions during which he or she appears to have been in the school while still under the age of 7. It is of course to be understood that the period during which each child is here stated to have been at the school is assumed only from the appearance or non-appearance of the name in the records, and may not in every case be correct.

1924-5			1925-6			1926-7	
Dan	18	(3 sessions)	Phineas	5	(2 sessions)	James	3
Christopher	5	(3 ")	Lena	2	(2 ")	Denis	1
Frank	5	(2 ")	Dexter	1	(1 ")	Joseph	0
Priscilla	3	(2 ")	Jessica	1	(2 ")	Alice	0
Tommy	2	(3 ")	Penelope	0	(2 ")		
Harold	1	(1 ")	Herbert	0	(2 ")		
Paul	1	(1 ")	Alfred	0	(2 ")		
Theobald	0	(1 ")	Conrad	0	(2 ")		
Duncan	0	(1 ")	Florence	0	(1 ")		
Benjie	0	(1 ")					
Martin	0	(1 ")					
Robert	0	(1 ")					
George	0	(1 ")					
Cecil	0	(1 ")					

The first thing which strikes one in regard to the above table is the fact that out of the 27 children, 14 - or more than 50% - are not recorded as having given any expression to such modes of thinking at all. Secondly, one notes that out of the 48 recorded instances, no less than 33 of these were occasioned by four children - Dan, Christopher, Frank, and Phineas - and that of these, Dan is responsible for 18.

Of course allowance must be made for the fact that some of these children were present in the school for a longer period than others, and so had more opportunity of displaying their mental powers. But even if we allow for this, Dan is relatively outstanding with an average of 6 per session, followed by Frank and Phineas each with 2.5 per session. James, who had only one session, has 3 to his credit; Christopher and Priscilla have an average "score" of 1.6 and 1.5 respectively, seven more have an average of 1 or less, and the remaining 14 have nothing.

It cannot of course be supposed that these records contain everything of interest which these children said during these three years; but what concerns us here is not so much the actual number of such expressions, but the fact that, having thus "creamed" the records of the best that is in them in this connection, this is seen to consist of a mere fraction of the total number of children, 4 out of the 27 being responsible for more than two-thirds of this material. Even if we include those instances where the expressions appear to have been extracted from the child by means of adult questioning, this only emphasises the result, since all of these were concerned with Phineas - one of the four children mentioned.

In making these extracts, the records have been given a most liberal interpretation, the term "inference", for example, having been given a wide connotation, including such cases as that quoted of James (p. 150) where, in referring to the size of the school, he says, "Then it must be big if it's bigger than an aeroplane - an aeroplane is such a big thing!" and the case of Conrad (p. 113, 11.12.26) where it is very doubtful if the child really understood the terms he was using.

Apart, however, from an inquiry into the cases of these particular forms of thought, a glance through the records in general will show how very frequently a certain few names recur. For example, in the records of "Discovery, Reasoning and Thought" for session 1925-26, Dan is quoted some 27 times, Christopher 20, Frank 9, Priscilla 9, Tommy 8, Phineas 3, Alfred 3, Dexter 2, Jessica 1, Herbert 1, and the remaining four children not at all. Thus over 50% of the total records under this heading for this session is the output of two children - two of the four already mentioned. Phineas appears to have arrived only after the first term and is not yet greatly in evidence - perhaps because of his age (2;11). But in the following session he occupies a very prominent place in the records, and he has no less than six consecutive pages almost entirely devoted to him in Section 2.

It is impossible to overlook these facts and to avoid the conclusion that these records as a whole, and in particular those instances which show evidence of these forms of reasoning, are mainly the outcome of a very small proportion of the children who attended the school. But the total group, as Mrs. Isaacs herself admits, was a highly selected one, with a mean mental ratio of 131; therefore it can hardly be maintained that these records show such thinking to be generally present during the earlier years - even in the case of highly intelligent children - and that therefore Piaget's thesis is disproved. There can be little doubt that Dan's thinking and behaviour do not conform to Piaget's conception of the child of that age, but he stands more than head and shoulders above the rest of the children, if we can judge by these records; and even if we add the three or four others who come next to him in prominence, we are still left with more than four-fifths of the children of whom little or nothing is said.

In the field of physics one exception will disprove a theory; but it is not the case in the field of biology, where a few departures from the rule do not disprove a general law. If Mrs. Isaacs could have shown four-fifths of her children to have the mentality of Dan, her conclusions against Piaget might have been justified. But the fact that her records have so little to say about the majority of the children, is full of significance; and it would be difficult to conceive of a greater tribute to Piaget's conclusions than this, that after three years of work with a highly selected group of children in the most stimulating of environments, her results should be so meagre.

But in this thesis we have adopted a rather different criterion of mental structure, one which, the writer maintains, is more fundamental than the criterion of ego-centrism used by Piaget, namely, the relation of the ego to its ideas, and which, in certain circumstances, will tend to <u>produce</u> ego-centrism. This does not mean that, given that mental structure in which ideas are still in a non-objectified relation to the ego, ego-centrism or syncretistic thought will <u>always</u> arise. In such a relationship the ego lives in the ideas, and because it cannot view them objectively, there will always be a tendency towards syncretism; but there is no reason why, on occasions, the right thoughts or conclusions should not be expressed by the child. The point is - not whether young children can produce statements which in themselves are rational - but whether these statements are, or are not, the outcome of <u>controlled thinking</u>. For the purposes of education the all-important distinction must be made between what a child can objectify and so control, and what comes from him as the spontaneous reaction to a given situation. In the latter case the reasoning need not be a conscious process; and an educational system which confuses these two phenomena, imagining the former to be present whenever it sees the latter, can only do injury to the child.

Therefore when we ask ourselves: "Can this or that child reason?" we must ask the further question: "Do his conclusions spring spontaneously out of the demands of the concrete situation in which he finds himself, or can he reason at will?" In other words, does the ego of the child control the reasoning process, or does the situation? In the former case we can make demands upon the child - we can ask him to think. In the latter case such demands can only be harmful.

In this connection we can see the folly of the procedure of "returning" a child's questions upon him and forcing him to discover for himself the answer which he expects of the adult. The fact that the child asks the question signifies that his own thinking powers are not yet ripe for the task of answering it himself, (except in cases of mere laziness); and we can succeed only in forcing into consciousness processes which still belong to a sub-conscious level. Equally pointless is the same procedure as a means of psychological investigation. If we worry a child with such questions we merely discover what is not normally there. We know already from the child's acts that categories such as causality are at work or in use subconsciously from the earliest years. But what is important for us to know is at what age these concepts come naturally into conscious use and later to objectification. The responses we obtain through badgering the child with his own questions tell us no more than that, if we dig deep enough, we can always drag something into the daylight; while such behaviour on the part of an educator who is anxious to "develop" the thinking processes by this means, is parallel to that of the impatient child who cannot wait until the plant appears above the surface of the earth, but must always be digging up the bulb to see how it is getting on.

The natural irritation which can be produced in the young child by such practices is aptly illustrated in the following example. In Appendix C to "Intellectual Growth in Young Children" we are given some further records of children "whose parents have been in touch with the methods of the school, and follow out those parts of the technique which are practicable in an ordinary home"; and in the section devoted to the "later history of James and Denis", we find the following (p. 356):

> "The boys (7;2) and (5;5) were with their father one evening in Golders Green Road. In the middle of the road there is a refuge with two red lights. Denis said to his father: "What are those lights for?" He replied, following his usual method, "What are they for?" James gets very annoyed with this way of dealing with questions; he said, "When people ask you a question what do they ask you a question for?" His father said: "Well, what do they ask you for?" James - "Because they don't know, and they want you to tell them!"

James, having suffered from this form of mental persecution for some time, is angry even when the victim is not himself, and he takes up the cudgels on behalf of his younger brother.

Of those parents who practised this technique with their children, Mrs.Isaacs adds (p. 355): "In particular, they meet the children's questions and expressions of opinion with frank respect and interest .."

This deference toward the child mentality does not operate apparently, on such occasions as this. To throw a question back at the questioner in this way, is the reverse of treating either it or the questioner with respect; and it is mere insincerity to maintain that our attitude to the child is one of respect towards all his forms of mental expression, while we ignore one of the most obvious of them - the natural expectation on the part of the child that the adult will answer his questions. But James's perfectly formulated rebuke is passed over in silence. In the long run, it is the previously formulated technique of the school to which attention is paid, and not the requirements of the child, whenever the two run counter to one another. The general educational theory is, respect for the freedom of the child and his modes of expression, and a meeting of his requirements with appropriate material and opportunity. But, as we have already seen, there enters into the practical technique an attempt to develop the adult type of mentality in the child - whether he wishes it or not - an attitude which is in direct conflict with the general theory.

Further, on the psychological side, there is the theory that the child, by being brought into contact with a varied environment, will give expression to modes of thinking which are not otherwise manifested; and Mrs. Isaacs complains of Piaget that his children were subjected to conversations instead of being brought into contact with the environment itself, as was done with her children. But it is just in so doing that she has failed to give us the very evidence which is of psychological importance. For it is only in the manner in which children are found to discuss an environment which is <u>not</u> present to them, that we are able to judge whether or not they are masters of their own thoughts, and therefore how far their thought-processes are ripe for direct training.

It is important that we should be awake to the real - if not always clearly conscious - aims of some modern educationists; and the tendency to make the child into a little adult is one of them. It appears to arise from the lack of a clear conception of what is meant by "thinking", no allowance being made for the different relationships which the ego may have to its thoughts. The danger of basing an educational system upon so superficial a psychology is obvious.

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We must now take into account the possibility that, while the changes in mental structure may follow more or less according to chronological age, the relative "brightness" of the ego itself may nevertheless vary with different children, and that a very bright child in this sense may be no further advanced in mental structure than a normal child of the same age. By "brightness" is meant the ability on the part of the ego to handle whatever mental events it may have under its control at the time. For example, a normal child of 7 can control mental imagery and can repeat three digits backwards. A brighter child, however, may be able to repeat four or even five digits in this way. It is a matter of the greater or less strength or agility of the ego in handling the material at its disposal. On the other hand, if the child has not reached the age at which his images become so far detached from the ego as to be objectifiable, ego-brightness can do little to alter that fact. A concrete example will illustrate this.

During the test conducted by the writer at Moray House school, among the 5-year-old children in the first year was a boy with an I.Q. of 160. In the test of repeating letters and digits backwards, he showed a ready understanding for what was required and made very strenuous efforts to perform the test, but he failed completely. After much coaching he was able to repeat only the one word "dog" correctly, and no numbers. He was unable to control the image, and fell back always into the forward order.

He was then 5;4½, with a "mental" age of 8;7. The following year (age 6;4½, M.A. 10;2½) he again failed in this test, succeeding in only one word (cry) and in two numbers. He still muddled the letters and the digits, and obviously realised that he was doing so. He was given the test a third time, at the age of 7;4¾ (M.A. 11;10), and on this occasion he was able to repeat all six words and numbers correctly and with obvious ease.

Here, then, was a child whose mental structure developed at the same time as that of the normal child, and yet whose "brightness" was 60% above that of the normal child.

The reverse of this is seen in the case of a boy aged 8;4 with an I.Q. of 79, which gave him a mental age of 6;7. According to his mental age he should have been barely able to pass the test, whereas in actual fact he did so with ease, being correct in all six words and digits. Thus in spite of his mental age he did without any apparent effort what the cleverer child at 6;4 (whose mental age at that time was supposed to be two years greater than this boy's chronological age) could not do. It is clear that structurally this boy's mentality was quite normal for his age, and that his backwardness must have been due to some deficiency in ego-development. (He also passed the "relational thinking" test.)

From these two cases one can see that so-called mental age is apparently no indication of mental structure - at least in regard to the change at 7; and yet, from the educational point of view, this change is one of the greatest importance. What, one might ask, would be the effect on the first-mentioned child had he been placed in a class more in accordance with his mental age and where demands would have been made upon powers of imagery-control which he did not yet possess? While it is plain that to have placed the other boy in a class of 6-year-olds (where theoretically he belonged) would have been to have starved him in the exercise of his mental functions.

We may thus assume that mental structure and ego-brightness are two different things, and that, as in the two cases cited, one child may have more than a normal ego-brightness with a normal mental structure, and another may have a normal structure but be subnormal in brightness. There may, of course, also be cases where the mental structure is retarded or advanced while the ego-development is normal; and the small percentage of 5-year-olds who succeeded in the imagery-control test may perhaps be classifiable under this heading. But whatever the situation may be, the structural factor must be taken into account before we can begin to talk about mental age in any really scientific sense.

The various forms of the Terman-Binet scale show that this conception of mental structure has not been adequately built into it, nor, in fact, to the Binet scale in general. We have seen how often in our qualitative analysis we have had to pass over a test as "non-significant" for a given age. By means of these non-significant tests a bright child may score a mental age to which, from the point of view of mental structure, he is not entitled. For example, to quote Burt's figures, although the "Fingers" and "5 digits" tests show a practically equal percentage of passes at age 7 (95.3% and 94.0% respectively), at age 5 they are passed by 62.5% and 37.3% of the children. Both tests belong to the 7-year level, but the second requires a certain imagery-control and the first does not.

Similarly, "Counting 20-0" and "Giving Date" are passed by 76.0% and 71.4% of children at age 8, but by 28% and 9.6% at age 6. Thus it is possible for tests to be equally easy at one age but not equally difficult at an earlier age. The difference would seem to be that one of them requires a mental structure which is present at the later age but not normally so at the earlier, while the structure required by the other is already in the process of development. In the last two tests mentioned, the one involves imagery-control and the other the objectification of ideas in relation. The former structure has already begun to develop at 6, but the latter begins only after year 7.

It is therefore possible to see how, by passing tests which belong to a higher age but which do not demand a higher mental structure - being more difficult merely in degree, - a child may attain a higher mental age than is justified by his mental structure at the time. It is theoretically possible, for example, for a child to be credited with a mental age of 10 without being able to objectify complex ideas in relation, - simply by repeating 5 digits backwards in place of the test for "absurdities", and by answering the two simpler "Comprehension" questions.

Moreover the full structural significance of even some of the "significant" tests is doubtful. For example, in the test for repeating three digits backwards or five digits forwards, the child is given up to three chances to produce one correct answer, and some children may pass after having made two errors. But it is plain that a child who can succeed in this operation only once in three attempts, does not yet possess a control over his imagery; and the 7-year level could hardly be credited with this particular structure were it not for other tests at the same age pointing to a similar structure and requiring a more satisfactory score.

Until a child can control his imagery, whatever his other mental attributes may be, he has not reached one of the most important stages of his development; and it is absurd to credit a child with a mental age of $8\frac{1}{2}$ - as in the case quoted - when he does not yet possess the mental control which is normal to the majority of children of 7. Mental test results, in short, are merely misleading from the educational point of view, if they ignore this factor of mental structure. If they are to be of value at all, they should be tests primarily of structure, leaving aside mere brightness as a secondary consideration. But a test is not a test of structupe unless it shows that the child can really perform the operation on the majority of occasions, allowance being made only for a slip. It was on this basis that the writer's test given to the Moray House children was made. It made demands which could be met only by children who had a natural and assured control over imagery, and yet it did not demand for each single operation more than the minimum degree of concentration necessary for such an operation at all. Taking three as the minimum number of letters or digits whose reversal can be said to produce a real problem in imagery-control, the function was demanded of the child two out of three times in each case, sufficient to show that the ability was normally present whenever called upon. To the child who really pòssesses the power to control imagery, this prolongation of the test does not make it more difficult, and the 7- and 8-year-olds rattled through it with ease; but it does so for those who can perform this operation only by chance, or with great effort, - i.e. for those in whom this mental structure is not yet fully developed. This is to be distinguished from the method of increasing the difficulty by making <u>each</u> operation harder, - e.g. by asking the child to repeat a greater number of letters or digits at a time, but requiring only one correct response out of three. Such a test is merely misleading, for it eliminates the child who can actually control imagery but who lacks the greater concentration necessary for such a task.

There is little doubt that Binet had originally in view this conception of different mental structures in the child at various ages, for in introducing his 1908 scale he says:

> "L'enfant ne diffère pas seulement de l'adulte en degré, en quantité, mais par la forme même de son intelligence; on ne connait pas encore cette forme enfantine; dans nos expériences actuelles, nous n'avions fait que l'entrevoir. Elle réclame bien certainement une étude." (27)

And Terman, in an article entitled "Mental Growth and the I.Q." (28) says that the Binet scale

> "is constructed on the theory that mental growth does not imply equal development of all the particular capacities at once, or in the same particular capacities at all periods; that certain differences in mental functions appear in a more or less definite order. It is adapted to bring out the fact that the 14-year-old, for example, excels the 7-year-old not merely in the maturity of certain mental functions, but that he is mentally able to do various kinds of things which the 7-year-olds can not do at all."

In spite of these statements, however, the factor of structure (or "form" of intelligence, as Binet expresses it) has never been clearly distinguished from the "quantity" factor - or degree of maturity within that structure - in the Binet types of scale.

In the 1916 Stanford revision, taking the 5-year level of achievement as a basis, we were able to find only three "significant" or new tests (structurally) at age 6, six or seven at 7, ("Fingers" being doubtful), three at 8, none at 9, one at 10, and two at 12. Thus, out of 48 tests in the years 6 to 12 inclusive, no less than 31 or 32 (two-thirds) deal with functions seen to be already present in previous years. What significance can we attach to a "mental age" derived from such a psychological mixture? How far does it represent the mental functions normally belonging to that chronological age, and how far merely the more skilful use of functions already present at an earlier age?

A closer view of this subject can be obtained by examining the 251 cases of 5-year-olds of Moray House school, the detailed records of which the writer has procured. These show that 106 of the children passed one or more of the individual tests beyond age 7; and it is interesting to note which of the 7- and 8-year tests these brighter children passed. Omitting the vocabulary test at year 8, the following are the figures:

Year:		Fingers	Pict.Descr.	5 Digits	Bow-knot	Concrete Diff.	Diamond
7	%	55.7	66.0	57.5	21.7	50.0	28.3
		Ball & Field	Counting 20-0	Compreh.	Similar.	Defin (sup).	
8	%	6.6	8.5	54.7	22.6	60.4	

It will be seen that the majority of these brighter 5-year-olds fail in the "Bow-knot" and "Diamond" tests, presumably because they have not the power of motor-co-ordination of the normal 7-year-old, but that, in spite of this, they can pass on to the "Comprehension" and "Definition" tests at year 8 and make up for this deficiency, as far as "mental age" is concerned.

As we have seen in our qualitative analysis, definition in terms of description involves merely a more complete objectification of concrete ideas than is involved in the concrete differences test, so that a child who can pass the latter may without much greater difficulty pass the former also. Repeating 5 digits, likewise, involving a certain control over imagery, belongs to the same function; while the basis of the test for comprehension is objectification of an imagined situation. This is apparently the easiest of all the relational thinking tests, as the majority of our percentage tables show, and is probably due to the fact that the situations to be considered are familiar and therefore require the minimum of concentration. But in the case of "Similarities" and the "Ball & Field" test much more deliberate thinking is demanded. In the first, a relating idea has to be found, and in the second there must be a grasping of the related possibilities of the situation and some form of planning in accordance with these.

In these Moray House figures there is a high correlation between the 5 digit and the concrete differences tests on the one hand, and the comprehension and definition tests on the other. Where one of these children passes the five digits test he also passes either or both of these 8-year tests in 52 out of 61 instances; while passing the concrete differences test is found to be accompanied by the passing of either or both of these other tests 49 times out of 53. On the other hand, the comprehension or definition test is passed in 96 cases out of the 106, and only in 19 instances unaccompanied by either "5 digits" or "concrete differences".

At age 5, as we have already seen, the average child can objectify the image of a total concrete situation. What the majority of these brighter 5-year-olds are able to do, apparently, is simply to achieve one aspect of the 7-year intelligence through a greater power of abstraction from that imagery. There is no evidence that they can control imagery to the extent that the 7-year-old is able to do it - as in the reverse repetition type of test, - for in "comprehension" and "definition" we have only the observation in imagery of a familiar situation and of a familiar object, while repeating 5 digits forwards is apparently an easier task than 3 digits backwards. (According to T.L.O., at age 5, 34% pass in the former and only 2% in the latter. See also Mary H. Young's Digit-span test.) Moreover, as already indicated, the majority of these selected children of 5 have apparently not the normal 7-year-old motor control. This is in agreement with the majority of the investigators quoted. T.L.O. gives, at age 5, 11% for the bow-knot test, and 4% for copying diamond; T. & C. and T.T.W. give 16% and 10% for the diamond test, and Cuneo & Terman 8%; while Bobertag and Goddard give only 32% and 43% at age 6. Burt and Rowe are the only exceptions, with 49% and 67% at age 5.

In short, these Moray House children do best - ahead of their age - in those tests which are less significant or non-significant for age 7 and 8, and fail most in those in which more controlled thinking, or motor co-ordination is required. The high percentage for "picture description" should be noted.

It may of course be argued that in the new scales "comprehension" now appears at year 7, and that "picture description" and "concrete differences" have been brought down to age 6. But "similarities" now appears at 7 also, while the diamond test is still retained at this level.

Only 9 out of the 106 children succeeded in any of the 9-year tests, and in 6 of these cases the only test passed was "five weights". One child passed both "five weights" and "finding rhymes", and of the remaining two, one passed "giving date" and the other "giving change". It will be noted that the five weights test is the most concrete of this series as far as relational thinking is concerned.

Thus we are again faced with the anomaly that a group of tests, all of which may be equally suitable for a given age, are not all equal for children a year or two younger. It means that while we must allow the same credit in mental months for each test passed by the older child, we ought not to do so in the case of the younger child. But that would be unworkable; and so the present system continues to exist at the expense of remaining dishonest.

The question of the constancy of the I.Q. is one into which we cannot enter here. It is sufficient to point out that, in so far as the ratio of M.A. to C.A. has been found in re-tests to be fairly constant, this may easily be attributable to the small part which structural development plays in the scale. For if structural development at each age were tested in an adequate degree, and tests of one structural level were not juxtaposed with those of another in the same year, fluctuations in test ability would show themselves round those ages at which structural changes take place - as shown in our graphs of test data when tests involving different mental structures are separated from one another.

This would not of course apply to the normal child who was able always to pass the tests just at the appropriate age; but a child a little in advance in structural development would tend to show, about the time of the 6-7 change, for example, a sudden rise in ability at an earlier age than his contemporaries, and so, for the time being, a higher I.Q.. A child, on the other hand, whose structural development was retarded, would show a low I.Q. during the time when the change was taking place in his contemporaries, reverting toward a more normal I.Q. later, when the change had taken place also in him.

The whole conception of I.Q. constancy, of course, depends upon the assumption that there are no such marked changes - a fact which appears to be in curious contradiction with the statements by Binet and Terman, just quoted - and the introduction into the scale of so many non-significant tests serves to blur any evidence of changes which there might be. It is thus possible to understand how a certain constancy of I.Q. can be attained, even in individual cases, while, taken in the mass, any irregularities which might remain will be averaged out. That this smoothing factor is not always successful, however, can be seen from the occasional expressions of doubt on the part of investigators, some examples of which are to be found in the following:

F. Mateer: "The diagnostic fallibility of Intelligence Ratios" (1918) (29)
Edgar A. Doll: The Growth of Intelligence: (1920) (30)
Bird T. Baldwin & Lorle I. Stecher: "Additional Data from consecutive Stanford-Binet Tests" (1922) (31)
Katherine Murdock & Louis R. Sullivan: "Some evidence of adolescent increase in the rate of mental growth." (1922) (32)
Gertrude Hildreth: "Stanford-Binet re-tests of 441 school children." (1926) (33)

C. S. Slocombe: "Why the I. Q. is not, and cannot be constant." (1927) (34)

Psyche Cattell: "Constant changes in Stanford-Binet I.Q.." (1931) (35)

Claude L. Nemzek: "The constancy of the I.Q.s of gifted children." (1932) (36)

Ralph R. Brown: Time interval between test and re-test in relation to constancy of I.Q." (1933) (37)

R. L. Thorndike: "The effect of the interval between test and re-test on the constancy of the I.Q." (1933) (38)

The fact that from such a scale a smooth mental growth curve can be derived, does not indicate that mental growth is smooth, but simply that the tests are so arranged that it appears so. For example, in "A method of scaling psychological and educational tests" by L. L. Thurstone (39), the author derives a growth curve based on his method of "absolute scaling", from Burt's percentages of London School Children. In figure 4 of this article, the central curve - which, according to Thurstone, represents "the mean intelligence of children of successive ages", is arrived at by slumping together every type of test quoted by Burt in each pair of consecutive age-groups. But in actual fact, this graph is no more than the response from year to year of the average child to a mixture of tests of all structural types - a mixture, moreover, in which the proportion of one type to another is constantly changing. It has no more meaning than if one were to weigh, at regular stages of their growth, irregularly varying mixtures of peas and beans. From the resulting series one could, indeed, plot a curve of growth, but it would be very hard to say what it could mean save that the objects tended to increase in weight with age. The shape of the curve would be meaningless unless we could ascertain how far its direction at any point was due to one or other of the ingredients, or merely to the varying proportions of the mixture.

In the article by C. S. Slocombe quoted above (34), the author calculates from the data of re-tests carried out by Baldwin & Stecher over a period of six years, commencing with children age 6, that the correlations between repetitions of the Stanford-Binet tests vary with the interval between them. This was also found by Thorndike (38) from the results of 36 experiments by various investigators. Slocombe concludes as follows:

> " .. it would seem that there is a factor common to early tests, causing the high correlation, and another common to late tests causing high correlation. But the comparatively low correlation between early and late tests indicates that the two factors are not the same." (p. 423)

If these conclusions are correct, this may well be due to the fact that the early tests are mainly concerned with control over imagery and concrete ideas, and the later tests with relational thinking; and these two functions, as we have seen, appear to have no genetic connection with one another. Thus there cannot be a single curve of mental growth, but only a curve for each separate function. Anything else is merely misleading.

In "The biological significance of intelligence tests" by David W. Oates (40) the author shows that "ability to speed" is a function which matures early and yields no further increase with age, and he concludes:

> "The score in an intelligence test is always a measure of a complex thing. . . A consideration of the data here presented emphasises the necessity for analysing the activities involved in intelligence tests from the point of view of the functional maturity of the processes underlying them. The nature of the

> curve of growth of intelligence may be determined largely by the appropriateness of the test material to the functional maturity of the processes to be expected at a particular age level." (p. 442)

A still smoother curve of mental development is arrived at by Thurstone in "The mental growth curve for the Binet tests" (41). As this curve is based on mental age, all that has been said above applies to this also.

Another factor in the Binet type of intelligence test which serves to conceal any irregularity in mental growth, is the fact that the tests for each year are specially arranged to suit the average child of that age, and that therefore any difference in the mental intervals between different consecutive ages can never come to light. In the article by Murdock and Sullivan already mentioned (32), the authors remark (p. 354):

> "The unit of mental age scales, by its very definition, is of such a nature that it tends to conceal any differences in rate of mental growth. Eleven years mental age means the mental age of the average eleven-year-old child. If, on the average, children should develop little mentally from 10 to 11 years of age, and develop much from 11 to 12, properly arranged mental scales, of the age standard type, would entirely conceal such change in the rate of development."

Baldwin and Stecher, in the article already quoted (31), make the same point (p. 560):

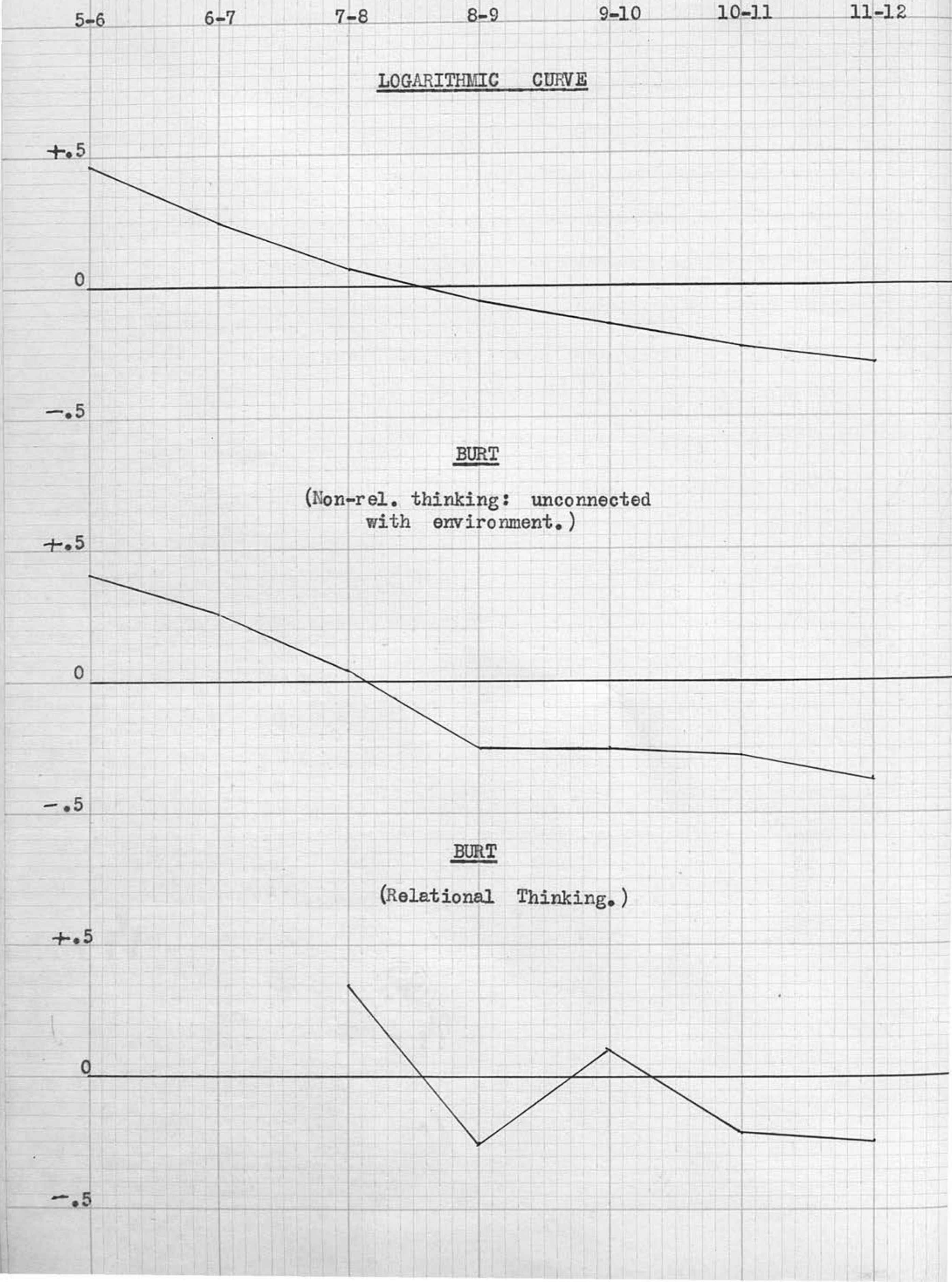
> "Mental age scales tend to conceal any differences in the rate of mental growth that may exist."

No one maintains, of course, that the mental intervals in the Binet scale are equal. On the contrary, in order to support the assumption that the I.Q. is constant, it has to be assumed that they are not equal and that the mental interval from 5 to 6 is equal to that between 10 and 12. The basis for this assumption lies in the distribution of mental age, in which it is found that the middle 50% of cases extends over twice the number of months at 12 than it does at 6, and that the distribution of I.Q. is approximately constant at any age. (Terman; 16). Our graphs derived from test data showed, certainly, that the rate of progress between age 11 and 12 is always less than that between 5 and 6 or 6 and 7, but there was no indication that between these points development of any of the three mental functions we have considered takes place according to this law.

In an article "Interpretation and Application of the I.Q." by Frank N. Freeman (42) the author points out that in order that the I.Q. should be valid, the curve of growth must take one of two forms. Either it is logarithmic, of the form y = log x, or it is straight. In the former case this would apply to all individuals, both above and below normal, the distance on the vertical axis of any given curve from the median being constant. (See figure 2 of article quoted). If, on the other hand, mental growth takes the form of a straight line, that representing individuals above and below normal would diverge from the median line, as shown in figure 3 of the article.

But while either of these possibilities satisfies the required conditions for I.Q. constancy as far as the ratio of the median to the other curves is concerned, only one of these satisfies the conditions in regard to the median curve itself. For not only must the median curve bear this ratio to curves above and below it; its own parts must bear this ratio to each other, so that the development between years 10 and 12 equals the development between years 5 and 6 - otherwise it does not

FIGURE 14.


5-6
6-7
7-8
8-9
9-10
10-11
11-12
LOGARITHMIC CURVE
+.5
0
-.5
BURT
(Non-rel. thinking: unconnected with environment.)
+.5
0
-.5
BURT
(Relational Thinking.)
+.5
0
-.5

satisfy the theory. Naturally this does not hold in the case of a straight line, but it does so in the logarithmic curve. If the I.Q. is constant, then, mental development must follow this curve.

If we now take the age-series 5 to 12 and work out "progress ratios" from the intervals between the logs of these numbers, we get the following results:

Age:	5-6	6-7	7-8	8-9	9-10	10-11	11-12
P.R.	+ .46	+ .24	+ .07	- .06	-.15	- .24	- .30

This gives us the data for a curve on the same lines as those we have already derived empirically, and if we superimpose this theoretical graph upon any of these it will be seen how far this theory of mental growth accords with the facts. The only graph to which it approximates is that of Burt for non-relational thinking unconnected with the environment, although the dip at 8-9 is of course ignored. Similarly it cuts through all the changes in the other graphs representing this function. Still less does it follow the course of relational thinking. It can be said only that it begins above the average line and ends below it, and in that respect it has something in common with practically all the empirical graphs; but it of necessity ignores the developmental changes which take place on the way (Figure 14).

That this theory of development does not correspond with even the rough facts - that is, with the results of all three mental functions slumped together - can be seen from the following. If we take from Tables 3, 15, and 28 (Burt's data) the S.D. intervals for the year 5-6, we find that the average interval (16 tests) is .81. Similarly, if we consider all the tests common to both years of the 10-12 interval (10 tests), we get an average interval of .72. So far, this is more or less in accordance with the theory. But the 8-10 interval similarly treated yields an average interval of .81 also (11 tests). This is not in accordance with the theory.

If we take Terman's own figures upon which his conclusions as to the theory are based (T.L.O. series), we find the following average intervals:

Age:	5-6	6-8	8-10	10-12
Interval:	.66	1.06	1.04	.64
No. of tests:	20	11	15	9

Here again 5-6 equals 10-12, but the theory does not hold for both the intervening intervals. Theoretically, calculating from the logarithmic curve, and taking .66 as a basis, the figures should be:

Age:	5-6	6-8	8-10	10-12
Interval:	.66	1.04	.81	.66

The actual figures for Burt's data are as follows:

Age:	5-6	6-8	8-10	10-12
Interval:	.81	1.40	.81	.72
No. of tests:	16	9	11	10

Theoretically, taking .81 as a basis, these should be:

Age:	5-6	6-8	8-10	10-12
Interval:	.81	1.28	1.00	.81

It will be seen that in both cases the theory breaks down in respect of the 8-10 interval- the period during which the development of relational thinking is taking place. In the Terman data, as we saw in the graphs, consider all the tests common to both years of the 10-12 interval (10 tests), we get an average interval of .72. So far, this is more or less in accordance with the theory. But the 8-10 interval similarly treated yields an average interval of .81 also (11 tests). This is not in accordance with the theory.

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Interval:	.81	1.28	1.00	.81

It will be seen that in both cases the theory breaks down in respect of the 8-10 interval- the period during which the development of relational thinking is taking place. In the Terman data, as we saw in the graphs, this development takes place a little later than in Burt, and this same fact reappears here. The greatest progress during the years 6 to 9 is already made, in Burt's data, by year 8, hence the 8-10 interval is too small for the theory. With Terman's data, considerable progress comes after year 8, and hence the 8-10 interval is too large for the theory.

If we were to add the 6-8 and 8-10 intervals together, we should get a fairly close correspondence between the theoretical and the actual figures in both cases:

	5-6	6-10	10-12
Burt: (Actual)	.81	2.21	.72
" (Theoretical)	.81	2.28	.81
Terman (Actual)	.66	2.10	.64
" (Theoretical)	.66	1.85	.66

But it is precisely during this middle interval that most of the changes we have been studying take place, and we should succeed only in blinding ourselves to facts which it is important for us to know. That these facts do not appear in Terman's curves of M.A. and I.Q. distribution is apparently due to the blurring effect of the scale in the calculation of mental age, since mental age can be achieved through passing tests which are structurally non-significant. When, however, calculations are made direct from the actual percentages of passes, fluctuations in development begin to show themselves; and these changes appear still more clearly when the different forms of thinking are separated from one another.

Even Thurstone's growth curve derived from Burt's total percentages is not so smooth as it looks. If we take the intervals between his figures for each successive year and calculate progress ratios therefrom, the results are as follows:

5-6	6-7	7-8	8-9	9-10	10-11	11-12
+.46	-.03	+.15	-.21	+.07	-.17	-.24

Here, in spite of the fact that his curve represents all types of test slumped together, the familiar "peaks" at 6, 8, and 10 already begin to appear.

The fallacy which appears to lie at the root of mental testing, and which Spearman (43) has effectively discussed, is the attempt to add the results of different mental functions together and to express the conclusion in unitary form. And further, as these functions - of which we have distinguished three broad cognitive types - do not develop at the same time or at the same rate, it is possible through the presence of non-significant tests to score a mental age for which the appropriate mental structure is lacking.

A teaching experience of the present writer's will further illustrate this point. He taught elementary classes for two years in a boys' school in Edinburgh, and at the beginning of the second session a boy aged 8;1 was sent up to his arithmetic class from the Kindergarten department. This boy had a reputation of being rather bright mentally and very careful and neat in his work. As the school was a small one, there happened to be no class at that time quite suitable for his age and scholastic level, and so it was arranged that he should do independent work in arithmetic under the writer's supervision while remaining in the Kindergarten class for the other subjects. This boy had an I.Q. of 119 and so was "mentally" 9;7 at this time.

The boy had begun to do long division in the Kindergarten class, and the writer continued this with him. At the same time the Kindergarten teacher introduced him to elementary grammar in the form of the parts of speech. But the boy's arithmetic home-work, which at first was exemplary in its neatness, grew more and more untidy. The figures became large and irregular and were scrawled obliquely across the page regardless of guiding lines in either direction, the size and irregularity of the figures increasing as the sum proceeded. One would not have recognised it as the work of the same child.

At first the writer ascribed this to some temporary laziness, and reprimanded the child. Later, however, nervous fidgetings and grimaces were noticed. This nervous tension was observed quite independently by the headmaster who communicated with the parents to inquire if anything disturbing had arisen in the child's home environment. The parents reported that the child was tending to lie awake at night, and on one occasion when the father had visited his room about 10 p.m. the boy, who was still awake, had remarked: "There are twenty nouns, aren't there, Daddy?"

At the writer's suggestion the grammar lessons and the long division were stopped at once, and he noted the obvious relief of the child when told that the long division would be given up meantime. Very soon the behaviour of the child returned to normal and his work resumed its former neatness.

The following term the writer had the task of trying to reintroduce this child to grammar, and he found the following. The child understood quite well what was meant by a noun or "naming" word, and by a verb or "doing" word, and could point accurately to a phrase in which such a word occurred, but he could not pick out the individual word. Instead of the verb, for example, the adverb belonging to it would frequently be pointed to. It was clear that the child recognised "action" in the phrase but could not abstract from it the specifically active word. This meant that he was capable of recognising in the phrase the presence of an element corresponding to a single idea; but his failure to cognise - in the light of this idea - anything but the phrase as a whole, showed that he could not yet cognise the words in relation to one another, i.e. the relation of parts within a whole at the level of concrete ideas. In short, it would appear, this child could not yet think relationally at the ideational level.

Nevertheless, before the end of the session, i.e. before he was 9, this child was able to distinguish all the parts of speech successfully and without any apparent strain. As we have seen, the simplest form of relational thinking reaches its highest rate of development between years 7 and 8, while tests involving this type of thinking first appear in the Stanford-Binet scale at 8, and in the new scales at 7. This boy began to succeed in work involving thinking of this kind about the age of $8\frac{1}{2}$, and was therefore, in respect of mental structure, not a day ahead of the average child and, if anything, slightly retarded - in spite of his I.Q.

The writer has unfortunately no record of how the boy progressed in regard to arithmetic, as he was in the hands of another teacher for this subject during the second and third terms. But long division, like simple grammar, presents no difficulties to the normal child of 9;7 years chronologically; and the incident goes to show how the health of a child may be endangered through assuming that his so-called mental age has any necessary connection with his mental structure.

A child may be "bright", but the scope of that brightness is largely conditioned by the mental structure in which the ego is free to operate. The one cannot be a substitute for the other. Ego-brightness may be termed the quantitative aspect of intelligence, and mental structure the qualitative. Real mental age will depend, obviously, on the structural aspect, and it is with this aspect that the genuine educator should be most concerned. He wants to know what a child can do or grasp naturally and without strain; and strain will obviously arise if a child is asked to objectify or manipulate ideas of a type which, even though he may act or think in terms of them, he is not yet able to bring into objective mental focus. In the case of the child just quoted, it was fortunate for him that the school was a small one and in which great personal interest was taken in the children, resulting in the blunder being noticed and rectified quickly. But what, one wonders, would have been his fate in a large school, placed on account of his mental age among 40 or 50 9-year-olds and in charge of a teacher who believed in the validity of the I.Q.? In all probability, punishment, first of all, for supposed laziness or carelessness, and ultimately nervous breakdown.

The other aspect of the question - the case of children who have the necessary mental structure for a task, but who are below the average in brightness, will be dealt with later in connection with a special teaching experiment carried out by the writer.

It may be objected that what we are criticising here is fundamentally the method of arriving at "mental age", and that in the Point Scale method of testing the conception of mental age has been abolished. But we do not abolish a conception merely because we cease to talk about it; and we cannot in fact get rid of the implication of mental age so long as we try to measure the intelligence of a child for scholastic or educational ends. For what does it mean in such circumstances except an assessment of his fitness for this or that level of mental work? And that is simply to assess him in terms of the school class for which he is thought to be fitted. The term "mental age" ceases to be implied only when we are dealing with adults.

If, then, mental structure is the important factor from the point of the educator, special attention must be paid to the periods at which these changes arise; and our graphs have seemed to show that these are connected with chronological age - a fact indicated by the abrupt increase in rate of progress when a certain age is reached, in spite of the tests involved not all being significant for the age in question. Graphs representing only significant tests would show, presumably, still more abrupt changes. This is shown in the two Moray House tests where the tests used were specially significant for the two functions concerned.

If maturity of mental structure varies at all from chronological age, it would seem to vary within narrow limits; and if this be so, it is more important for the educator to know the chronological age of his pupils than anything which an ordinary mental test can tell him. But there are still those who, given even uniformity of mental structure in a class of children, would nevertheless hold that it is essential to divide the bright from the dull, on the grounds that it is impossible to teach both adequately at the same time. With this educational point we shall deal in the final section.

In the meantime, the writer has tried to show that the only sound method of gaining an insight into the intellectual needs of the child is through the "direct" method of approach. He has described the type of test which must be applied for the discovery of "structure", and how it happens that ordinary intelligence testing fails to bring out these structural differences. Further, it has been shown that these various levels of structure consist of a particular relation of the ego to its ideas and images, and of these (in the earliest years) to the motor system, and that these structures tend to appear in connection with chronological age. These structural factors, it has been pointed out, must be distinguished from the factor of ego-brightness which is describable as the quantitative factor in intelligence. Finally, it is maintained, that it is this structural aspect, rather than that of brightness, which is of importance from the point of view of the educator.

This raises certain educational problems which will be discussed in the concluding section.

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PART 5.

SOME EDUCATIONAL CONCLUSIONS

In our introductory remarks we referred to the practice in present-day schools of introducing certain subjects at an age or in a manner the appropriateness of which seemed to be in need of psychological investigation. It would now appear that a subject should be introduced to the child at the age at which he attains the appropriate mental structure, and in a manner which conforms to that structure. Taking as illustration the subjects which were mentioned, it is clear that the understanding of Algebra involves primarily the ability to objectify an abstract idea. Arithmetical terms, such as are found at least in the use of the "four rules", are always referable to concrete objects. But an algebraical symbol is referable in turn only to some number. It is purely abstract. Further, an algebraical term represents two or more abstract ideas in relation. Thus, referring to table 2, we can see that the earliest age at which purely abstract ideas begin to be objectified is 11 or 12, while objectification of abstract relational concepts appears first at 12. It would therefore seem unwise to attempt to introduce this subject before the age of 12.

In regard to Geometry we have a somewhat different situation. In this, as in Algebra, we are dealing with abstract ideas; and although figures are drawn to illustrate the arguments, these are not intended to be taken literally. They are merely a symbol for what is being discussed, and one of the first things which the pupil must learn is that "proof"2 is something independent of the empirical figure.

To follow the argument of a theorem, one must be able to objectify abstract ideas in relation, for these are the material of the argument. But to reproduce the argument in other than parrot-like form, or to carry out any kind of constructive geometrical thinking (such as exercises or problems on a theorem), involves the ability to manipulate the ideas concerned. Our table does not indicate when manipulation of abstract ideas begins; but we have seen that objectification of mental imagery is possible some two years before it can be manipulated, and that concrete ideas, objectifiable at 7, are probably not manipulated until age 10. We have good reason to expect, therefore, that manipulation of abstract ideas will not be present much before 14 or 15.

It is true that in the new Terman scales manipulation of abstract ideas, in the form of a sentence-building test (using abstract ideas as components) appears at the "Superior Adult 1" level. But at this stage one suspects that the vocabulary element also enters into the test and that a younger person might fail simply through unfamiliarity with the words. As the authors admit:

> " . . . . in the present instance success depends less upon the ability to combine isolated elements into a meaningful whole than on word comprehension. Failure is rarely due to inability to combine the words into a single sentence." (p. 289-290)

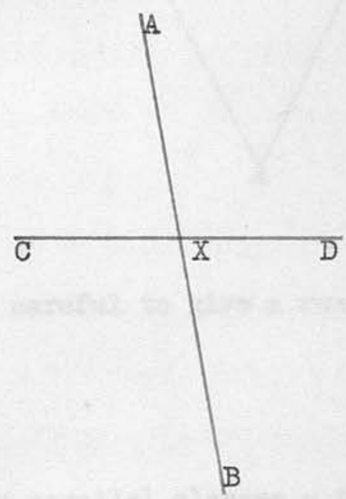
Leaving aside the question as to the age at which manipulation of abstract ideas actually arises, the present writer carried out an experiment to discover how far it is correct to say that it is not present at age 12-13, the age at which theoretical geometry is today begun in most schools being 12+.

A test consisting of three geometrical questions was drawn up, the first being a simple problem on triangles, the second, a question dealing with the difference between equality in angles and in triangles, and the third a problem dealing with the size of angles.

The test was given in three secondary schools in Edinburgh to children who had begun theoretical geometry not more than six months previously, and who had had experience in solving problems of this type. One of the classes had not covered all the ground necessary for question 3, and these children are not considered in the results of this part of the test. The three questions were as follows:

1. See if you can do this little problem:-

AB and CD are two straight lines bisecting one another at X.



Join AC and DB.

When you have done this, you have Two triangles, ACX and BDX.

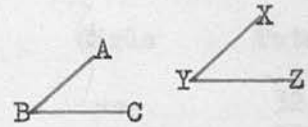
Prove that these two triangles are equal (congruent).

<u>Be careful to give a reason for everything you say.</u>

WRITE YOUR PROOF HERE:-

(Space allowed for proof)

2. Here are two angles, ABC and XYZ
<u>They are both the same size of angle.</u>



Now take your pencil and produce the line BA right to the edge of the paper, calling this point "D". Then produce the line BC, in the same way, right to the edge of the paper, calling this point "E".

What would you say about the sizes of the two angles DBE and XYZ?
Are they equal in size or not?

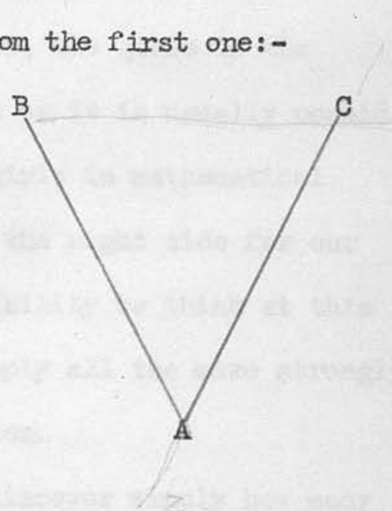
WRITE YOUR ANSWER HERE:-

Now join XZ.

What would you say about the sizes of the two triangles DBE and XYZ?
Are they equal in size or not?

WRITE YOUR ANSWER HERE:-

3. Here is another little problem, different from the first one:-



Here we have two straight lines, of the same length, meeting at A.

First of all, join BC and produce it beyond C to a point X.

Now produce the line CA in both directions, producing it beyond C to a point Y, and beyond A to a point Z.

Now here is the question:- If the angle YCX = 70°, what is the size of the angle BAZ?

Write down every step in your proof, and be careful to give a reason for everything you say.

(Space allowed for proof)

In school A the test was given to three parallel classes - the brightest class and two others, in school B to two average parallel classes, and in school C to one class - the brightest. The details are:

			Boys	Girls	Total
School A.	Class	1.A1.	32	--	32
		2.A4	33	--	33
		2.A5	38	--	38
School B.	Class	1.B2	17	21	38
		1.C2	22	15	37
School C.	Class	1.A1	14	24	38
		Total:	156	60	216

There are thus two classes consisting of the brightest children (1.A1), two rather less bright (2.A4 and 2.A5), and two mediocre or perhaps rather below average (1.B2 and 1.C2), the number of children in each of these groups being 70, 71, and 75, respectively, with average ages 13;0, 13;5, and 12;11. The average age of the whole group of 216 children is 13;1. The whole should therefore form a fairly representative selection.

Unfortunately, as School A was a boys' school, the girls in the total group are very much in the minority. But as it is usually considered that boys tend to have a superiority over girls in mathematical subjects, this unevenness of distribution is on the right side for our purpose; and if the conclusion shows that the ability to think at this level is not present in this group, it should apply all the more strongly to a group more equally distributed as regards sex.

In this experiment we are not concerned to discover simply how many children were correct in each test and how many failed, for a child might have the mental structure necessary to fulfil the task, and yet lack the brightness to do so successfully. In solving a geometrical problem one must be able not only to manipulate abstract ideas, but also to think of the right ideas to manipulate - to remember, for example, the theorems which might be appropriate to the particular situation. For this reason a child may fail in question 1 through a mere lack of ability to see on what lines the argument should go, and not through any lack of power to handle abstract material.

On this account we shall not take into consideration those cases in which a child failed to complete questions 1 or 3; but every child who gives us a completed argument believes that he or she has solved the problem; and our present concern is how many of these have failed, and why. For a child who is content with an incorrect argument is one who, in making arbitrary assumptions or deductions, has failed to fit abstract ideas into their proper relation.

In order to manipulate these ideas for the correct solution of such a problem, one must be able to use ideas and relations taken from different theorems. That is, ideas and relations from different contexts must be fitted together into a new context. To cognise ideas and relations in a given context is one thing, but to lift these from their context and, relating them to other ideas, build up a new context, is quite another. New links have to be formed and a new pattern made. It is in this forming of new relational links that manipulation is involved. As in the case of the young child who, first perceiving objects in imagery as part of a concrete situation, is able only later to abstract from this imagery and to manipulate separate images, - or, being able to objectify concrete ideas in relation is not yet able to manipulate these ideas into other relations (as in "sentence-building", for example) - so it is in the case of abstract ideas. These are first met in a related context, and the child has still to develop the ability to transfer them from that context and to manipulate them into another. To be able thus to transfer ideas, however, is to be distinguished from the ability to know which ideas to transfer. The latter belongs to knowledge and brightness, the former to mental structure.

As examples from the geometrical experiment will show, the child who is not yet able to manipulate abstract ideas tends towards two types of error. Either he simply makes arbitrary assumptions in order to prove what he wants to prove, in which case he does not even attempt to transfer ideas from another theorem; or, in transferring ideas, he brings with them relations which belonged to the ideas in the original context but which are not applicable in the new. In other words, instead of uprooting the appropriate idea and transplanting it cleanly into the new context, he brings with it other ideas or relationships which cling to it by virtue of their former connections. Thus, while he is able to grasp abstract ideas in relation in a given context, he is apparently unable to disentangle them from that context.

The following is an example. Boy: age 12;4: Class 1.A1. School A. Answer to question 1:

> "Proof: CX = DX (given)
> AC = DB (given)
> $\angle C = \angle D$: straight line CD cut by transversal AB, cutting at X.
> Compare two triangles ACX and BDX.
> Apply point B to A and line BD along AC, so that D lies on C, and line BX lies along AX.
> Therefore the triangles are congruent."

After making a purely arbitrary assumption (AC = DB) he transfers an idea - rather confused - from the theorem on parallel lines, making $\angle C$ equal $\angle D$. Then he transfers the idea of superimposing triangles from the theorem dealing with two sides and the included angle, together with some of the "given" data belonging to it. Thus in both of these transferences relations are carried over which do not hold in the present case.

The following is another of the same type: Boy: 12;5. Same class.

> "Compare triangles ACX and BDX so that point B falls on point A and line BX lies along AC.
> We have AC = BX and AX = BD (given)
> " " $\angle A = \angle B$, $\angle C = \angle D$, $\angle X = \angle X$.
> Therefore triangle ACX and triangle BDX are equal in all respects."

This happens in a number of cases. The proof of a theorem of congruency (usually that of two sides and included angle) is transferred wholesale with the "given" elements of that theorem, and applied here without any reference to the "given" of the present problem.

The theorem on parallel lines also keeps intruding, presumably because the lines AC and DB, being parallel, suggest it.

Here is the case of a boy; 12;6 : same class:

"$\angle$DXB = $\angle$AXC because they are vertically opposite.
$\angle$CAX = $\angle$DBX because alternate
$\angle$BDX = $\angle$ACX because alternate
Three angles of one triangle = Three angles of another.
Therefore Triangles are congruent."

In the following case from the same class (boy; 12;11) we have mere juxtaposition of statements which have no logical connection:

"Compare two triangles ACX, BDX.
We have AC equal to DB (construct.)
Therefore triangles ACX = BDX
We have two sides and an included angle of a triangle in the one, and two sides and an included angle in the other.
In particular $\angle$C = $\angle$B."

And again: Boy: 13;4: (same class)

"$\angle$AXC = $\angle$BXD (vert. opp.)
$\angle$ACX = $\angle$BDX (alt.$\angle$)
Therefore triangle AXC and triangle BXD are equal in all respects.

Lastly, we have the purely arbitrary type: Boy: 13;9: (same class)

"Angle A in the first triangle = angle B in the second triangle.
" C " " triangle = " D " " " triangle.
Line AC in the first triangle = line BD in the second triangle.
" CX " " triangle = " DX " " " triangle.
Therefore the triangles are congruent.
Therefore the triangles are equal in all respects."

Thus we have cases varying from those who make no attempt at all to solve the problem by means of manipulation of the available ideas, to those who try to do so but who fail through inability to free the ideas from the empirical situation from which they were taken.

Among the more elementary sources of confusion are: the assumption that triangles are congruent because the respective angles are equal: that AC and BD are equal because they are parallel: and a tendency to prove the problem by means of the empirical figure, either by measurement or by means of the apparent visible equality, etc., of the lines and angles. The following is an interesting case illustrative of this last type of error, pathetically mingled with tit-bits from one or two theorems which even in themselves have not been understood. Yet the child obviously thinks that he understands the situation. This is a boy, age 13;3, School A. Class 2.A4. (It should be noted that all the cases quoted hitherto are taken from 1.A1 - the brightest class).

> "To prove: That the two triangles are congruent.
> Proof: Since straight line AB and CD bisect at X.
> Lines AC and DB are drawn. If they are compared they are found to be equal. This is because that the straight line AB cuts CD and forms vertically opposite angles. These are joined at the points at the end and so become equal to one another. Another way is when they are placed together after they have been cut exactly. Two of the ends meet the other two and when you look at the third point it is exactly resting on the other point. This makes the two congruent."

With regard to those cases giving a correct solution, the following minimum type of answer has been accepted:

AX = BX (given)
CX = DX (given)
$\angle$AXC = $\angle$BXD (vertically opposite)
Therefore triangle ACX = triangle BDX.

Formal reference to the congruency theorem on which the final step of the argument is based has not been insisted upon. Of those who refer to it, reference is either by enunciating the theorem, or by the actual process of applying the one triangle to the other, in the manner of proof of that theorem. In about two-thirds of the correct answers reference is made to the theorem.

To accept the word "given" as an explanation of the equality of the lines AX and BX, CX and DX, instead of a more direct reference to bisection, does not preclude the possibility of a mere mechanical transference of the data from the original theorem itself; and, in fact, in the great majority of cases merely the term "given" is used. But reasonable leniency is desirable in this experiment.

On the other hand, a mere statement as to the equality of the correct lines and angles has not been accepted. The danger of doing otherwise is exemplified in the following case where all three steps are factually correct, and yet where the reasons given show that the proof has not been understood at all. (Girl: 12;6. School B. Class 1.B2)

"AX = BX (because AB is a straight line)
CX = DX (both perp. to AB and they are one straight line)
$\angle$AXC = $\angle$BXD (because AB bisects CD at X)

These "reasons" are plainly a blind transference from some quite irrelevant theorem which the child has "learned" but not understood.

Those cases, however, showing correct answers but without reasons, have been noted, and their number kept separate from those in which the argument is definitely arbitrary or nonsensical.

One other point must be mentioned. This test was given to schools A and B in February of the session in which theoretical geometry had been begun (i.e. in September of the previous year), and to school C in March. In every case the ground necessary for the solution of questions 1 and 2 had been covered, and practice in problems similar to question 1 had been conducted in the ordinary course of the school work. Unfortunately, it was afterwards discovered that in school C actual theoretical geometry had not been begun until the beginning of the second term, and question 3 was not possible for these children. But the groundwork for questions 1 and 2 had been done.

No restrictions as to time were made in administering this test. The teacher giving the test was asked to allow half an hour or more, if necessary, and to eliminate the time factor as far as possible.

The following are the results for question 1:

Total number of children attempting the test:	216		
Number who completed the question:	176		
Number of correct answers, with reasons:	37	or	21%
Number of correct answers, without 3 reasons:	9	or	5%
Number of arbitrary or nonsensical answers:	130	or	74%

The percentages are of course based upon the 176 children who completed the question to their own satisfaction.

In question 3 we have a task of a less theoretical nature, in which ideas taken from three different theorems are involved in the discovery of a concrete fact, the size of a specific angle. The errors here, however, are of a similar type, consisting mainly in arbitrary assumptions based either upon the appearance of the figure, or upon transference from other theorems or problems. Of the first kind are: that line AB equals line BC; or that the triangle is equi-angular; or that exterior angle BCY equals exterior angle BAZ. Of the second kind are: that angle BCA and angle BAZ are equal because they are "corresponding" angles; or that angle YCX and angle BAZ are alternate angles.

Still another variant is a transference from a theorem which itself has been misunderstood, such as, that the exterior angle of a triangle being equal to the sum of the two interior opposite angles, we have only to halve the value of the exterior angle in order to arrive at the value of each of the two interior angles concerned. Thus the argument runs:

$\angle YCB = 110^\circ$
Therefore $\angle CBA = 55^\circ$ and $\angle BAC = 55^\circ$
Therefore $\angle BAZ = 125^\circ$

Some examples of this transference from other theorems are almost impossible to follow. Here is a case of a girl: 12;9. Class 1.C2; school B:

"$\angle YCX = 70^\circ$ (given)
$\angle YBC = 110^\circ$ (adjacent angles formed by two straight lines)
$\angle XCZ$ = less than 180° and more than 90°, adjacent angles formed by two straight lines.
Therefore $\angle BCA + \angle CAB + \angle ABC = 180^\circ$, 3 angles of a triangle.
" $\angle BAZ = 110^\circ$, angles about a point make up 360°.
Because $\angle YCX = 70^\circ$ and triangle ABC $= 180^\circ = 250^\circ$.
Therefore $\angle BAZ = 360^\circ - 250^\circ = 110^\circ$."

On account of the fact that school C had not covered all the ground necessary to answer this question, and also because, being the last of the three questions it suffered most from the time element, only 65 children completed this part of the test. The answer to this problem being numerical and therefore open to guessing, no account has been taken of answers which are not accompanied by some attempt at argument. The results are as follows:

Total number completed:	65	
Total correct:	17	or 26%
Correct, but insufficient reasons:	1	or 1.5%
Incorrect:	47	72.5%

These percentages, it will be noted, are very similar to those resulting from question 1.

Question 2 is of a rather different order. We have here a test of the ability to comprehend two abstract ideas and the relationship between them, - that of an angle and of a triangle. As the child in this test must be able to view almost the same situation in terms first of one idea and then of another, it serves to demonstrate his ability to move freely among such concepts. It is essential, of course, that both parts of the question should be answered correctly. All that is required is a simple "Yes" or "No", although some children have also attached reasons for their statements. A few of these (10 in number) have given the correct answer but attached the wrong reason, and these are therefore counted as having failed. Some also have given no answer to one or both parts of the question. Those failing to answer both parts have not been considered, as well as those answering correctly in one part but omitting to answer the other. But any case in which only one part is answered and that incorrectly, is counted as a failure.

The number of cases discarded through lack of completion is 18. There is also another type of case in which an incorrect drawing of the figure, or a misunderstanding of the question, appears to have caused a wrong answer. These cases, also 18 in number, - some obvious, some doubtful, - have also been set aside. There thus remain, out of the 216 cases, 180 answers with which we can deal.

The great majority of the errors have to do with the second part of the question - the triangles. The following are the results:

Total number completed:	180	
Correct:	82	or 45.5%
Incorrect:	98	or 54.5%
Of those who failed:		
Error in regard to angles:	21	or 21.5%
" " triangles:	71	or 72.5%
" " both:	6	or 6.0%

From this we may gather that more than half of these children were incapable of handling such elementary geometrical ideas, the great majority of those who failed being unable, apparently, to pass without confusion from the conception of an angle to that of a triangle. There is no question here of manipulation of ideas; it is merely a switching-over from one idea to the other. But this ability to free oneself, at will, from the consideration of one idea and to take up another, is an essential preliminary to manipulation; and it should surely be present in 100% of the children of a class before we expect them to enter upon the theoretical stage of geometry.

It is not to be supposed that these children would be incapable in other circumstances of judging that, of two triangles, the one which is large enough to contain the other is the bigger triangle. Their difficulty apparently is to grasp all the attributes of the concept "triangle" at one and the same time, and not to be misled into viewing a triangle from its angular aspect only. This is exemplified in those cases where the child has added a reason for a wrong answer to the "triangle" part of the question, and which has been done in nearly half of these cases, (33 out of 71).

In 17 of these it is categorically stated that the criterion is one of the size of the angles. Actual examples are:

"Yes, because the angles are equal."

"They are equal in size, because no matter how small they are, or how large, the three angles together make up 180^{o}."

"Yes, they are equal, because if the three angles of each triangle were measured they would be exactly the same number of degrees."

"Triangle XYZ is equal to triangle DBE. It is the amount of turning that counts."

" B in first triangle = Y in second triangle.
E " " = Z " "
D " " = X " "
Yes."

One boy, having failed to produce BA right to the edge of the paper, is prevented from viewing DBE as a triangle. He therefore answers:

"No, because DBE is not a triangle and XYZ is a triangle . . "

So far, the answer would be legitimate in the circumstances. But he adds:

"Triangle XYZ is larger, because the three angles of a triangle make up together 180^{o}."

The belief here seems to be that a figure is larger than another if the sum of the degrees contained by its angles is greater. The following case shows the same view very clearly:

"The angles of triangle XYZ and DBE are equal. The size of the sides do not count, but the angles do."

The following shows the child's inability to grasp the concept of triangle in its entirety and to hold together as parts of one concept the double aspect of sides and angles. This girl (12;7) cannot combine the two but wavers between what are to her, apparently, two incompatible ideas, deciding finally upon the irrelevant one:

"The actual sizes of the triangles are not equal, but the angles of the one are equal to the angles of the other. Therefore DBE = XYZ."

In 11 cases out of the 33, the "angle" criterion of size is not specifically stated, but is implied. The following are examples:

"No (because DE and XZ are not parallel)"

"No, the triangles are not equal as XYZ has a sloping side and DBE has not."

"No, they are not equal in size because XYZ is an acute angle and DEB is a right angle (I measured it with my protractor) therefore triangle DBE is not equal to triangle XYZ."

"The two triangles DBE and XYZ are not equal in size. The only angles that are equal in the two triangles are $\angle$DBE = $\angle$XYZ."

This reference to DE and XZ not being parallel, or that the angles involved by them are not equal, is due to the fact that X and Z did not happen to be drawn equidistant from the edge of the paper - an accident which of course in no way affected the test.

The following cases are interesting as indicative of indecision between the two criteria:

"As above, DBE is bigger in size" (from the first part of the question it is clear that he means 'length of arms') "but in degrees triangle XYZ has more."

"They are the same size in angle although one has been enlarged."

"The triangles are (words omitted) size but their areas are different." ('the same size' is presumably meant.)

This apparent inability to grasp at one and the same time both the angular and the linear aspects of the concept "triangle", seems to show that such ideas are not yet fully objectifiable by these children. They cannot bring both aspects into mental focus at once. In other words, it is the relationship which they cannot objectify. It is, of course, a more subtle relationship than anything which will confront them in elementary algebra.

The remaining 5 cases have to do with sides rather than with angles, and in three of these the "argument" is obscure. But the remaining two cases are worthy of note. One is a boy of 13;1, from the brightest class in school A. He has proved the congruency problem of question 1 correctly, with a reason given for every step, and with the argument laid out and written in a manner that would gladden the heart of an examiner. One would say that here, at least, is a child of 13 who understands what he is doing in geometry.

His answer to the second part of question 2 is as follows:

> "They are equal.
> Two straight lines (BD and DE) and an included $\angle$DBE =
> Two straight lines (XY and YZ) and an included $\angle$XYZ.
> (Congruent)"

The other case is that of a boy (12;8) from class 1.A1, school C:

> "Yes, they are equal in size because of the proposition: If two triangles have two angles and a side of the one equal to two angles and a side of the other."

He has evidently had this proposition well engraven on his memory, for he also "proves" question 1 by means of it.

In this connection it must now be added that of the 37 children who had successfully completed question 1, and thereby indicated, apparently, that they were capable of understanding congruency and something of the method of geometrical proof, no less than 12 failed immediately afterwards in the angle-triangle question, showing thereby that they succeeded in the first question not through insight but by some mechanical means; two failed to give any answer to the question; and one drew the figure incorrectly. The remaining 22 were correct. Of those 12 who failed, 6 failed in the "angle" part of the question, 5 in the "triangle" part, and 1 in both.

Thus we cannot say that 37 out of 176 children (21%) showed understanding in the handling of a simple geometrical problem, but, at the most, 25 or 14%. The average age of the 22 who passed in both questions 1 and 2 is 13;4, 6 being under 13 and 2 over 14. It is perhaps worth noting that the average age of these children is <u>above</u> that of the total group of 216 children, which is 13;1. Normally, it should be the duller children who tend to be above the average age in a school group of the same scholastic level. This departure from the rule, as far as it goes, points to the fact which the whole of this experiment seems to show, that the child at the age of 13 has not yet the mental structure necessary for geometrical thinking.

The plain facts are, that out of this group of 176 children, 86% failed in questions 1 and 2 - which does not mean, be it noted, merely that 86% of a group of children failed to find the solution to a problem, for that would be a fact of little moment. It means that this percentage failed out of a group of children who believed that they had found a solution, and that their errors were not those of ignorance of fact or carelessness of calculation, but were due to inability to handle the material with which they were expected to work. The result shows a kind of "syncretism of reasoning" at the abstract level.

The positive evidence supplied by this experiment is supported by the fact that no Binet test up to the 12-year level involves the ability to manipulate abstract ideas. It is probable that this first appears with adolescence. In the meantime, it is difficult to see what educational advantages are to be derived from the teaching of theoretical geometry to children of 12-13. In even the best class in our present group of children - class 1.A1, school A - which has the highest percentage of passes in both questions 1 and 2, the actual numbers are 7 out of 32 boys, or, if we consider only those who have completed question 1, 7 out of 25 - that is, 28% of a group of children presumably selected for their brightness.

Apart, however, from the question of educational advantage, with which an examination system does not appear to be greatly concerned, it is possible to see how examination results in this subject can nevertheless be achieved. For if it is possible that out of a group of children who solve a problem of congruency successfully, one third do not know the difference between an angle and a triangle, it can readily be understood how theorems can be learned and repeated, to the complete satisfaction of the examiner, by quite a large percentage of children who need not in the least understand what geometry is about. The embarrassing readiness with which previously learned theorems can be quoted has been seen in this experimental test; and there is no reason at all why all this knowledge should not be utilised by the children to secure good marks in an examination.

So long as no other criterion than that of the class exercise and the examination is used, the fallacy which underlies the assumption that children of 12+ can grasp geometry, will remain unnoticed. The fallacy is, that the ability to grasp abstract ideas in relation, and so to <u>follow</u> an argument involving these, is not the same thing as the ability to free these ideas and relations from that context and to manipulate them correctly in another context. There is little reason to doubt that the first begins to be possible at age 12. The Binet scale shows this, if we accept the Terman scales as valid for this purpose; while, apparently, children of that age are able to learn and repeat theorems. But this is not geometry. It is merely the repeating of an argument which has been learned. The whole educational value of the subject, it is hardly necessary to say, lies in the reasoning being produced - or reproduced - out of the free rational activity of the individual, and not merely from his memory. A theorem, to be really understood, must be grasped in its universality - not merely as a particular argument printed in a school-book - and must be reproducible by the individual in any context.

Geometry should not be taught until this kind of mental structure is present; and theorems "learned" in these earlier years can in no sense be a training for the rational activity which develops later. One cannot train a mind for an activity the necessary structure for which is not yet present. The most one can do to the mind in such circumstances is to strain it.

As already pointed out, ideas of any kind are first met in a context. To manipulate them involves the abstraction of them from that context, and this, in turn, involves the ability to view them in a universal light and independent of that context. This means that the ideas must be objectified in their full abstractness; and manipulation is thus reducible to a question of the objectification of ideas. A concrete idea, for example, is not seen in its most abstracted or isolated form until it can be defined in terms of an abstract idea - in class definition. This is possible at age 9 or 10 according to the majority of Binet test investigators; and it is at these ages that we have seen manipulation of imagery and of concrete ideas also to be present. Previous to this, ideas are not found completely isolated or universally viewed, but are seen either in a related context ("Comprehension 3"), or in terms of some particular aspect or quality ("Differences" and "Similarities"), or in terms of parts within a whole (Definition by description). Thus manipulation appears to be made possible through a further stage of objectification; and the inability of more than half of the children in the "angle-triangle" test - not to manipulate - but simply to pass from one concept to the other, was also due to this lack of complete objectification of the concepts involved.

The situation in regard to this premature teaching of geometry was aptly illustrated in the course of a conversation which the present writer had with an intelligent schoolboy. The boy - age 14;10 at the time - who is well known to the writer, was aware that the latter was engaged in some research work, and one day asked what this work was. The following is a copy of a note made of the conversation immediately afterwards:

> "Asked me what my research work was. Explained it was endeavour to find changes in mental growth, so as to discover when certain subjects should be taught. He replied that this could surely only be found through actual trial of what children could grasp. I pointed out that the difficulty was to discover exactly when they <u>did</u> grasp it.
>
> Then he told me that it was only during the previous term (age $14\frac{1}{2}$) that it suddenly dawned on him that geometrical reasoning was meant to be <u>applied</u>. Commencing theoretical geometry at 12+, he had always, he said, been able to <u>follow</u> the arguments of theorems, and had learned them simply as something to be learned. But "riders" had always puzzled him, in that he could never understand how people knew the solutions. He took it that the arguments in regard to them had to be learned, like those of theorems. Now, however, he saw how reasoning could be <u>used</u>."

This appears to be in accordance with the conclusions we have reached. The apparent suddenness of the mental change, at the onset of adolescence, is interesting. The note of the conversation concludes as follows:

> "Then he added that he supposed school teachers were quite satisfied so long as they could get examination results (meaning that they did not trouble about whether the age was appropriate or not). I pointed out that many people in the educational world did not recognise that such sudden changes exist. His reply was: "Well, there must be a hanged lot of fools in education!""

Without associating oneself, necessarily, with the opinion here expressed, this last remark is interesting in that it indicates the degree of certainty with which the boy regarded the fact of his own mental change and its abruptness.

In this geometry test we have seen an example of the unsuitability of a subject to the mental structure of the children to whom it was being taught. We shall now examine the problems involved in the teaching of another school subject, namely, grammar; and a series of experiments carried out by the writer will be described, in which an endeavour was made to teach this subject in a manner suitable to the mental structure of the children concerned.

The mental structure of the child between the ages of 7 and 12 is characterised by the fact that concrete ideas can be objectified in increasing stages of complexity, but not purely abstract ideas. These begin to appear about 12. If, then, we wish to teach the child in accordance with his mental structure, we shall refrain from demanding of him during these years that he should objectify abstract ideas.

At 8-9 the child reaches a point when relational thinking is developed; and this, therefore, is the period at which grammar can be suitably introduced, since grammar deals with relations between words. But grammar can be nevertheless a very abstract subject, and it is frequently taught as such - to the aversion of the majority and the bewilderment of the dull.

During two years of experimental teaching in the small private school previously mentioned, the writer had the opportunity to tackle this problem. The problem is briefly this:

Grammar consists primarily of two complementary approaches to a study of the sentence - a study of the parts ofspeech and their relationships, and a study of the sentence and its structure. The fact that the child at this age can define a concrete idea in terms of class would seem to suggest that he should be able to recognise the parts of speech. But in grammar we are not concerned with the definition of a word in terms of its meaning (as in the question 'What is a horse?') but in terms of its function _quae_ word. We are classifying words and their relationships, not the meanings of words. Now a word, _per se_, is an abstract idea, so that when we ask a child to classify words - i.e. to objectify them- we are approaching the 12-year level of thinking. In this way grammar may be very abstract and therefore unsuitable for the child of 8-9.

But as we have seen that - according to the tests - a child can define a concrete idea in terms of use or function several years before he can do so in terms of class, we shall remain more within the framework of his mental structure at this age if we describe the parts of speech to him in terms of their function - speaking to him not of nouns and verbs, but of "naming-words", "doing-words", etc.. There is a tendency today to introduce this form of terminology into grammar textbooks and into teaching. The problem still remains, however, as to the best way of illustrating these functions. The task is not so difficult in the case of the parts of speech, but it is another matter when we come to deal with the other aspect of the subject - the structure of the sentence - and are faced with the problem of demonstrating the "function' of such concepts as "subject", "predicate", and "object". The difficulty is, of course, that we are dealing here primarily with structure, and function hardly enters into the matter.

To grasp the grammatical structure of a sentence involves the objectification of abstract ideas in relation. How is this to be presented to the child of 8 or 9? This is the realm of the most abstractly handled, and hence badly taught, aspect of grammar; and the process of sentence "analysis" usually involves ruled columns in an exercise book in which the different components of the sentence, ruthlessly torn from one another, are locked up in separate compartments labelled "Subject", "Enlargement of the Subject", Predicate", and so on. When a sentence has been thus shredded and tabulated, it remains a mere jumble of words, and the sentence itself - whose structure we are supposed to be examining - has ceased to exist.

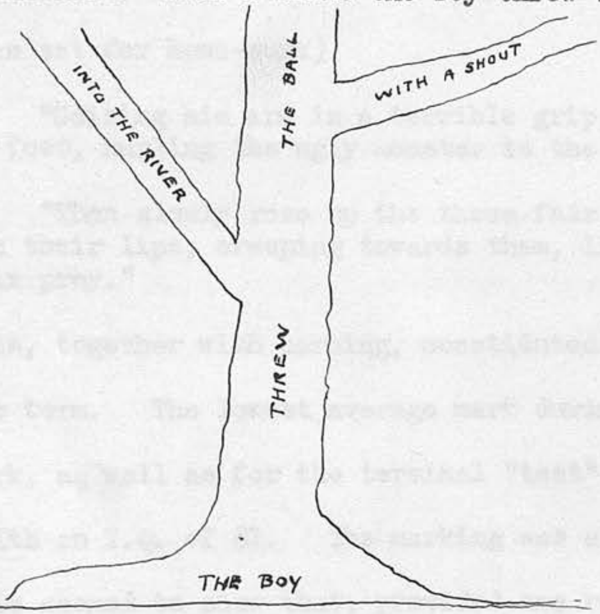
If we consider the child's mental structure between the ages of 7 and 12, we shall find one golden rule for the teaching of any subject during this period. During these years the child is able to objectify only concrete or complex ideas, and as complex ideas are concrete ideas in relatiɱn, (the relation itself not yet being objectified), we can see that concrete ideas constitute the framework of all the child's objectified thoughts at that time. But the essential fact about a concrete idea is, that it is very closely allied to the mental image. It is something which can be pictured. Hence, teaching during this period should always be pictorial in character. It should appeal to the child's imagination.

How can grammar be made pictorial? If so abstract a subject as this can be so treated - especially that of sentence-analysis - it will be unnecessary to demonstrate the possibility of this in the case of more concrete subjects.

The problem is one of translating an abstract relationship into pictorial terms, and the following method was adopted by the writer in his actual teaching of this subject. Proceeding from the belief that the sentence is, above all things, an organic structure, the writer concluded that in analysis this organic nature must never be lost sight of. Hence he likened the sentence to a tree or plant, having a root, stem, and branches. The subject of a sentence together with the verb and the object (if any) are as inseparable as the root and main stem of a plant, while "enlargements" of the subject or object, or "extensions" of the predicate, belong to these in the relatively separable manner as branches belong to the plant. One can remove branches without destroying the tree, but not the main stem or the root. In other words, one can remove the "branches" of a sentence and the remainder will still make sense; but if one removes the root or main stem, it no longer makes sense.

This the children understood very easily, and sentences were analysed in this way, an outline of a plant or tree being drawn and the sentence written along the stem and branches thus:

(Sentence: With a shout the boy threw the ball into the river.)



Here we have grammatical analysis expressed in a picture, and one which retains the sentence in a recognisable form. It is analysed into its component parts, and yet we can still see how it all belongs together. By this means the structure of the sentence was readily grasped by the children, and soon quite elaborate sentences were dealt with, involving branches growing from the root, stem, or higher portion, according as they represented enlargements of the subject or object, or extensions of the predicate. Later, branches growing from other branches were introduced, so that the child was able to grasp im a picture the manner in which the different phrases depend upon the main body of the sentence and some of these, in turn, upon one another. In this way the manner in which one phrase may "modify" or "qualify" another could be understood.

The children enjoyed the work, and at the age of 10-11 sentences such as the following were successfully tackled: (These were actual sentences set for home-work)

"Seizing his arm in a terrible grip, Beowulf leapt swiftly to his feet, hurling the ugly monster to the ground."

"Then slowly rose up the three fair sisters with a cruel smile upon their lips, creeping towards them, like leopards creeping on their prey."

This, together with parsing, constituted the work in grammar during the last term. The lowest average mark during that term for grammar home-work, as well as for the terminal "test", was 66% in both cases, - a boy with an I.Q. of 81. The marking was always strict and accurate.

This seemed to show that, provided one remained within the mental structure of the children, they could grasp these grammatical relationships with ease and tackle even quite complex sentences. The most noticeable feature was, that these children had no difficulty in spotting the "root" or subject of the sentence, even when this was masked behind introductory phrases, as in the above examples. Normally, this is a very frequent type of error. When analysis is taught by the usual method, the child, floundering in a sea of abstractions, grasps at some imagined "rule" - such as, that the subject of a sentence is always the part which comes first, with the predicate in the middle, and the object at the end; and so, when he is presented with an inverted sentence, he is lost. The children taught by this method experienced no difficulty of this kind. They had no need to think in terms of "rules". In this "picture" they had something which they could grasp.

The class referred to, however, consisted only of nine boys whose

I.Q.s were: 81, 91, 106, 111, 111, 114, 117, 119, 126. The writer therefore was anxious to try a similar experiment with a greater number of children and of more average brightness, and also with backward children.

An opportunity for the former was afforded him some time later while visiting a school in London. He arranged to give five lessons in grammatical analysis, using this method, to a class of 30 children there, age 10-11. I.Q.s were not available, but these children were non-selected, being grouped solely according to age. After the completion of the series of lessons, a test was given at which there were two absentees, reducing the number to 28 (14 boys and 14 girls). The children were drawn for the most part from the rather poorer middle class of a London suburb.

These children had had no teaching whatever in analysis of the sentence, grammar having been confined up to that time to the parts of speech. The lessons were given on a Tuesday and Wednesday of one week, and on the Tuesday, Wednesday, and Thursday of the week following. The test was given on the Friday. In the test two sentences were given, and the children were asked to draw a plant or tree and write the sentence along it in the appropriate way, indicating by the placing of the phrases the subject, predicate, and object, with extensions. The actual grammatical terms were not introduced.

The two sentences were as follows:

"The old man walked with a happy smile toward the knight."

"In the lofty hall the visitor lifted the great sword from the table."

The first sentence has a subject, predicate, and two extensions; the second, a subject, predicate, object, and two extensions. The point of importance in the first sentence is, of course, that it has no object, while in the second the subject is "masked" by an introductory phrase. The exact "placing" of the branches - i.e. attaching them to the lower, middle, or upper part of the stem according as the phrase was an enlargement of the subject or object, or extension of the predicate - was not insisted on. Naturally, one could not go so far in five lessons. In four cases a child made the one branch grow out of the other. But this also is something the significance of which he could not fully understand at this stage. What was aimed at in these early lessons was to teach the children to distinguish subject, predicate, object, and any form of extensional phrase. This is very much more than is usually attempted in so short a time. The results were as follows:

Sentence	1.	27	correct	out of	28	or	96%
"	2.	22	"	" "	28	"	78.5%

The error in two of the six failures in sentence 2 was due to one of the two extension phrases having been omitted, and not to any confusion of them with subject or object. Of the remaining four, two had the subject wrong, and two the object. Thus one can say in regard to sentence 2, that 24 out of the 28 understood how to distinguish between these four parts of the sentence, that is, nearly 86%.

In teaching these children the writer experienced the same interest and enthusiasm on the part of the children as he had observed in the Edinburgh school. They were able to grasp the elements of sentence-structure almost at once, as the figures themselves show, and the confusion and difficulties which usually attend this branch of grammar were almost entirely absent.

The third experiment undertaken by the writer in this connection was with a group of dull children. He approached the headmaster of an elementary school in a poor working-class area, namely, South Bridge School, Edinburgh, with the request that he be allowed to teach grammar during one term to the dullest children of the most backward class which had received just one term's teaching in grammar. This request was readily granted, and six children (four boys and two girls) were selected by the class teacher as being the most backward in this subject, and of whom she had been able to make little or nothing during the previous term. The ages of these children at the beginning of the experiment were: 9;11, 9;6, 10;0, 10;3, 9;11, and 10;9, and their I.Q.s were respectively, 97.5, 88.5, 83, 80, 79, and 75.5.

The grammar teaching during the previous term had consisted of formal analysis of the simple sentence and was being continued during the term in question. The writer taught these six children in a separate room each time a grammar lesson was being given to the remainder of the class - which occurred twice per week for a period of half an hour; so the time given to them in this subject was the same as they would normally have received in their own class.

The "tree" method of analysis was used, the children using at first coloured chalks for their drawings. Towards the end of the term ordinary pencils were substituted and the formal grammatical terms introduced, when the children were taught how to "translate" into formal terms what they had previously written along the trunk and branches of the tree. Thus a tree was first drawn and the sentence analysed in terms of it, and then the usual formal series of columns for subject, predicate, object, and extension, was drawn out below and the appropriate sections filled in. In this way the children were brought into line with the remainder of the class in regard to method, in order that they should not find themselves at sea on their return.

At the end of the term a test of three sentences was set and given by the headmaster who afterwards corrected and marked the papers. The test consisted of the following sentences:

1. The little boy loved the animals.
2. The kind driver patted his horse on the back.
3. Yesterday the children played a game in the park.

A mark was given for each item of analysis, of which there are 12.

From the report made by the headmaster (reproduced below) it will be seen that the lowest score was 8 out of 12, made by a boy with an I.Q. of 75.5. It will be noted also that, in the class examination at the end of the third term, three of the children had profited by the experiment to the extent of gaining 3 out of 5, 4 out of 5, and 5 out of 5, in the grammar question. The remaining three, on the other hand, had fallen back once more.

HEADMASTER'S REPORT

"During the second term (about three months) of session 1934-35 Mr. Pelham Moffat was given permission to carry out an experiment in the teaching of grammar to six of the backward pupils of class Senior 1.D (1st. year of the senior division - ages 9-10 years). At this stage the analysis of the simple sentence is begun and this class had started formal analysis at the beginning of the session. These six pupils were chosen by the class teacher for the experiment as they had shown little or no progress in this work.

Mr. Moffat's experiment was an endeavour to show that with pupils of low I.Q. a pictorial method of teaching this abstract subject would make a much more definite appeal and be more likely to have lasting effects than the mere formal teaching of this difficult subject. I shall leave the description of Mr. Moffat's method to himself and deal with the matter from the point of view of general results.

To begin with, the children obviously enjoyed the time spent with Mr. Moffat, the drawing & the colouring involved in working out their sentences had a direct appeal to these backward children. Through hand and eye they found an approach to a subject, which, when presented in formal teaching, had, on the whole, been quite unintelligible to them. There is no doubt in my own mind that from this point of view the experiment was successful. In fact, even with children of average and over-average intelligence I am convinced this method of approach is valuable. Indeed most good teachers use some concrete method to begin with and then discard it, as is only right, when they think their pupils have grasped the essential principles of analysis. With backward children, however, the period of using some concrete method would have to be a fairly long one and probably with very backward children they would never be able to make the change over to purely abstract reasoning.

From the point of view of time it would probably have been more satisfactory if the experiment could have been carried on for, say, two or three terms in order to find out the permanent effects of this method.

However, even in the short time available it was clear that advance had been made, but, I think, from further observation since the end of the experiment some of the children would require to use this or some other concrete method for a longer period.

The following table gives some details in connection with the experiment:

Pupil	Date of Birth	I.Q.	* Headmaster's Test (unprepared) given at end of experiment on 2/4/25, pupils using Mr. Moffat's method.	* Teacher's Class Test given 28/6/35 in the ordinary way and not using Mr. Moffat's method.
				Analysis of S.Sent.
A	5.7.25	88.5	11 marks out of 12	Correct: 5/5
B	6.2.25	97.5	10 " " " "	(Partially (Correct: 3/5
C	28.12.24	83.0	9 " " " "	Wrong: 0/5
D	22.2.25	79.0	10 " " " "	(Nearly (Correct 4/5
E	12.10.24	80.0	10 " " " "	Wrong: 0/5
F	12.4.24	75.5	8 " " " "	Wrong: 0/5

* This test consisted of 3 simple sentences
No. 1. Subject and Predicate
No. 2. " " and Object.
No. 3. " " " and Extensions (2)

⊕ One simple sentence with Subject, Predicate, Object and 2 Extensions.

WILLIAM J. S. LITTLE,
Headmaster,
South Bridge School,
Edinburgh."

5th July, 1935.

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There is no reason for doubting that all six children would have maintained the level gained had pictorial teaching been continued after the period of the experiment. During the experiment itself they received, of course, much more personal attention than they would have received in their own large class; but the marks gained at the end of the experiment were proportionately high, especially for backward children, and a lower standard of achievement would still have been adequate for them to have kept up with the remainder of the class. This method was used because it is in accordance with the mental structure of the child at that age, and should therefore be maintained so long as that structure remains. It is not a question merely of using such a method as a convenient way of helping lame dogs over styles, and then of discarding it as soon as examination marks can be secured without its aid.

From the three foregoing experiments it seems clear that if we approach the child in terms of his mental structure he will be found to give an immediate and marked response, whether he be bright or dull, and that, in consequence, the bright and the dull can be taught together provided one has respect to this mental structure in the method of teaching. Hence, if mental structure is, as it appears to be, a function of chronological age, children of the same age should be given the same kind of teaching, and there should be no difficulty in regard to teaching bright and dull together in the same class.

The bright, of course, can always be pushed on; and it is usually believed today that we do a service to the super-normal child if we provide him with the means of utilising his powers of thought beyond the usual level of his years. It is thought that we thereby assist his development into a brilliant adult. It is not considered that we may merely harm him by encouraging his greater mental energy to find an outlet on higher levels of abstractness of thought, instead of confining his activities to the plane of his normal mental structure. The superficial criterion of the I.Q. tends to blind us to this possibility.

It is not a question of getting children to think abstractly as quickly as possible and of making them into adults before their time; it is a question of giving them the kind of mental food which they can assimilate without strain, and strain will arise when a child tries to bring into mental focus ideas which he is not yet normally able to objectify. A concrete case has already been quoted. The extent to which he tries to force such ideas into focus will depend, naturally, upon the strength or "brightness" of the ego of the child. A dull child will not try. He sits in class and allows everything beyond his reach to flow past him. The bright child will make an effort to grasp it. But on this account it is to the bright child that more harm may tend to be done.

It is therefore no cause for rejoicing that, for example, among the children of our geometrical test, at least 14% were apparently able to handle geometrical concepts. On the contrary, it may almost safely be said that when 86% of a group of children of a given age show themselves unfit for a given type of mental work, it can hardly be anything but a strain upon the resources of the remainder. For mere scholastic attainment, with the incredibly shallow criterion of the examination system, is not what we must look to, but to the effect of our teaching upon the whole after-life of the child. The fact that a child can repeat theorems, and even understand them, at the age of 12, has no educational significance whatever - although those reponsible for the school curriculum seem to regard it as an essential. What has significance is the kind of mind which, as a result of our educational efforts, that same child will have at the age of 40. If we succeed in inducing him at 12 to perform mental operations for which he is not yet ripe, what effect will this have upon his mind as an adult? Or, conversely and more generally, at what age ought this or that subject to be taught, and in what manner, so that the future adult may have the maximum of initiative, creativeness, and mental elasticity? And how far is the evident lack of these qualities around us due to a premature intellectualisation of the child at school? Until such questions are inquired into, education cannot even begin. What goes on under that name at the moment appears to be a more or less efficient system for the preparation of examinees.

It is not suggested, of course, that modern education has no ideals. Theoretically, the aim of the modern school is to prepare useful citizens.

But in practice, the criteria, apparently, of what is good for the child to receive as a means to that end, and the age at which he should receive it, are the exigencies of the examination system and the age at which he can produce paper results. In regard to geometry, such results can just be achieved at 12, and apparently no earlier; while the ground necessary to be covered for the purposes of a school certificate, prevents the postponement of the subject until later. It is between these two mill-stones - the limit of what the child can visibly stand, and the pass limit of a state examination - that future "citizens" are ground.

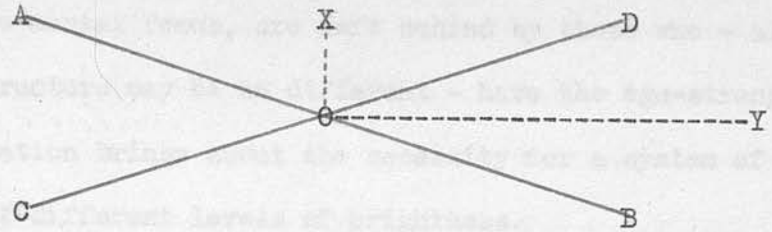
A pathetic instance of the criterion of paper results was seen by the writer while visiting school B in connection with the geometry test. The teacher in charge of these classes handed him copies of a series of ten geometrical exercises which he was in the habit of using for these children, and by means of which he found it possible to achieve results. One of these is reproduced below. The original is in the form of a duplicated sheet which is handed to the child for him to fill in. It will be seen from this that just that factor which we found to be lacking in the child of this age - the factor of manipulation of the ideas - is here supplied by the teacher, and so, naturally, results can be obtained.

EXERCISE 4.

"Use the following statement:-

Adjacent angles formed by two straight lines make up 180°.

AB and CD intersect at O. $\angle$AOD and $\angle$DOB are bisected by OX and OY. Prove $\angle$XOY a right angle.



<u>Given</u> AB and . . . . intersecting at O
$\angle$ . . . . . . bisected by . . . and $\angle$ . . . . . . by . . . .

<u>Required to prove</u> . . . .

<u>Proof</u> $\angle$AOD is bisected by . . . .
$\therefore \angle XOD = \frac{1}{2} \angle$ . . . . . .
. . . . is bisected by . . . .
$\therefore \angle$ . . . $= \frac{1}{2} \angle$ . . . .
$\therefore \angle XOD + \angle$ . . . . $= \frac{1}{2}$ ($\angle$ . . . . . . + $\angle$ . . . .)
But $\angle AOD + \angle BOD$ = ... (. . . . .)
$\therefore \angle XOD + \angle$ . . . . = ...
That is $\angle$XOY is . . . .

Q.E.D. "

It is no discredit to the teacher in question that he should employ such a method as this. On the contrary, by such means he provided a protection for the children from a mentally harmful situation. It indicates, moreover, that he knew precisely what mental powers they lacked. But the existence of such papers is a testimony to the psychological ignorance of those responsible for the curriculum.

Apart from such devices, however, it is plain that the introduction of a subject too early, or the teaching of it in a too abstract way, has the effect of splitting in two any unselected group of children of a given age. The duller children, being unable to force the required ideas into mental focus, are left behind by those who - although their mental structure may be no different - have the ego-strength to do so. This situation brings about the necessity for a system of parallel classes of different levels of brightness.

The present procedure in schools, it would thus seem, starts at the wrong end. First of all, teaching unsuitable to the child's mental structure is given, either through ignorance of that structure or on account of the exigencies of a curriculum dictated by official examinations, and then it is found that it is impossible to teach the bright and the dull together. Thereupon some criterion of division is found necessary, and some scholastic or mental test is employed; and as neither of these adequately indicates the mental structure of the child, being largely an assessment of mere brightness, they fit the requirements of this artificially created situation. And so, whether judged by scholastic attainment or by I.Q., those children who are best able to force their mental structure to suit scholastic requirements are segregated from those who - more fortunately for themselves, perhaps - are less able to do so.

If, however, in contrast to this present topsy-turvy procedure, we were to consider the needs of the child to be the first essential in education, and so seek to give him only what is appropriate to his mental structure at any given age, we should find that these difficulties do not arise, and such forms of testing would become superfluous. For if a teacher has before him a class of children to whom he is about to teach algebra, the really important thing for him to know about these children is not which among them are bright and which are dull (he will discover that soon enough), but whether or not their mental structure is such that they can think naturally in terms of abstract ideas. If they can do so, he will find, of course, that the bright children can do so more quickly or can cope with more complex situations, while the dull will handle their material more slowly. But these are facts of secondary importance. For what makes the subdivision of a class imperative is not that some pupils are slower than others - that factor is always present in even the most carefully selected group - but that some pupils cannot really grasp the subject at all. This was clearly shown in the case of the grammar experiment. A clear distinction must be made between mere slowness in handling those ideas which are objectified, on the one hand, and inability to objectify the ideas, on the other.

If the development of a child's mental structure is retarded and he cannot objectify the ideas normal for his age, that is quite another question, and how far this is the case is a matter of investigation. His I.Q. will not necessarily show it, as we have seen. As the grammar experiments showed, however, there would appear to be a wide range of children over which the requisite structure is normally present. The backward children in this case had no lack of the power to objectify concrete ideas in relation - else they could not have succeeded so well as they did. The fault lay - not in their being unable to handle concrete ideas - but in the fact that in their own class they had been expected to deal with abstract ideas. They were certainly slow, but - kept within the framework of the structure normal for their age - the subject was by no means beyond their grasp.

It is probable that a lack of the mental structure normal to a given age is one of the basic characteristics of mental defect. This would appear to be so from the graphs of Burt's M.D. children, where relational thinking first appears at 9 instead of at 7, developing most during the 9-10 interval instead of during the year 7-8; while the type of thinking which develops in their case prior to age 10 - showing similar fluctuations to that of the normal children - is, however, of a lower level of structure. To sum up, we must distinguish between dullness of ego, and absence of normal mental structure.

These general considerations in regard to education can be fully illustrated in the case of a school in which they were actually carried out. During a three months' visit to a well-known school in Germany the writer had the opportunity of seeing how education can be conducted with a view to meeting the actual needs of the child in the manner indicated above. This school (closed, unfortunately, in April 1938 on account of its not conforming to National-Socialist requirements) was the well-known Waldorf School in Stuttgart, which was conducted on Rudolf Steiner's educational principles and founded in 1919 with some 250 pupils. So successful was the school that its numbers increased to over 1000 by 1926 - a level which was more than maintained until the change in the German Government in 1933, when certain restrictions began to be placed upon the flow of pupils. The school was co-educational, and catered for children from nursery-class age up to university matriculation.

Broadly speaking, the principles adopted involve the presentation of the school subjects to the children at such an age and in such a manner as will meet their actual mental needs, and at the same time the use of these lessons as media for the ultimate harmonious linking of the intellectual, affective and conative elements in the adult. The introduction of certain subjects too early, or in too intellectual a manner, it is claimed, tends to divorce the intellectual from the conative element, and to weaken the affective and imaginative. The result of this, it is held, is a type of adult whose thinking does not come to fruition in action, or one who is subject to the domination of conative impulses devoid of accompanying thought; while the damping down of the affective-imaginative element in the child tends to kill what would become the creative element and the source of initiative in the adult.

It is pointed out that in his earliest years the child expresses himself largely in terms of the conative element - in action and imitation. Later the imaginative and affective element predominates, showing itself in phantasy and in a love of rhythm. Only in the adolescent period, it is claimed, does the intellectual element appear in comparative separation from the imaginative and affective. Until that time, thought is largely imaginative and closely bound up with the feelings.

As the physical organism of the child is busily engaged in building itself up during the earlier years, the bodily proportions not being properly completed until about the age of 6 or 7, it is maintained that demands of any kind upon the child's thinking should not be made before that age - the period of commencement of the second dentition. To do otherwise is to impare the health and vitality of the organism.

During the middle period (7 to 14) teaching must remain concrete and imaginative or pictorial, and it is held that teaching of an abstract or intellectualistic kind during these years has a two-fold effect. First, it neglects and so starves the feelings and imagination, causing these to seek unhealthy forms of expression, while the link between thought and conation is broken. Moral ideals, for instance, which tend to appear in adolescence, will tend to remain as mere ideals, finding no affective support - no "bridge" whereby they may pass over into action. Impulse, on the other hand, will have no adequate intellectual or affective check; while the feelings and imagination, seeking stimulus from external sources and depending more and more upon these for their satisfaction, will lose their own spontaneous creative powers.

Secondly, it is pointed out, to develop thinking in separation from the other elements mentioned - not in itself a bad thing at the right age - involves the development of the critical judgment. Judgment, however, has two aspects. It involves not only the power to dissect and analyse, but the ability to enter with understanding into the subject or situation judged. Understanding, however, except in the case of purely abstract subjects, involves more than mere intellectual ability. It demands imagination, feeling, and experience. It is what may be termed the positive or constructive aspect of judgment, whereas the analytical element may be termed the negative or destructive side. A balanced judgment requires both. But if we develop the purely thinking element in young children, we develop the critical element in advance of understanding and experience, and we awaken in the child the merely destructive side of judgment. We thus engender an antipathetic, destructive attitude toward life unbalanced by the sympathetic and constructive; and this, coupled with an affective nature which, being starved craves for unhealthy excitement, can readily produce anti-social tendencies.

Thus, it is claimed, not only the mental but the moral side of the child's nature is damaged by too early intellectual teaching. It is not merely a question of trying to counteract the intellectualism of one lesson by cultivating the child's aesthetic powers in another, giving - for example - theoretical geometry during one period and an art lesson during the next. This is already done in the ordinary schools and is there believed to constitute a "balanced" education. The bad effects of one lesson cannot be thus nullified by another. One might just as well try to counteract the effects of an indigestible breakfast by following it with a digestible lunch. By such a procedure we merely inhibit the beneficial assimilation of the lunch also. It was always the aim of the teaching in the Waldorf School to avoid producing this indigestion in the first place, to avoid presenting any subject during these years in abstraction from feeling and imagination. It was not that the children were not trained to think in these earlier years after the age of 7, but that their thinking was kept within the realm of the concrete and the pictorial - within the realm of what can be grasped in concrete ideas and imagery. This, together with a continual development of the feelings, not only in art and music, but through a humanistic and artistic element pervading every subject, led the children gradually into an attitude of sympathy and understanding toward human life and toward nature; and thus their understanding developed side by side with their awakening powers of thought.

By this means, not only was the creative element of imagination kept alive, but the affective side of their life was both fed and developed, harmoniously linking thought and conation. Then, when with adolescence the child's thinking tended naturally to take a more abstract turn, aesthetic and intellectual teaching became clearly divided, as in the ordinary school; but the moral ideals which the young individual could now form for himself, found support and not hindrance in an affective nature which had been continually cultivated to that end throughout the previous seven or eight years of school life.

This is a brief and very inadequate account of the general manner in which education was conducted in this school. It omits many aspects of great pedagogical interest, but which, on that account, are not entirely relevant to the present discussion. It takes no account, for instance, of the particular ways in which the moral or aesthetic feelings were developed in and through the ordinary school subjects, the manner and use of punishment, the method of discipline at the various stages, and the way in which otherwise abstract subjects were kept within the realm of the pictorial. An indication of this last aspect, however, will be given presently.

It is sufficient now to give some idea of the ages at which the principal school subjects are introduced in accordance with the above principles. No scholastic teaching is given before the age of 6-7. The children are kept in the nursery class until that time, where anything that might be learned - such as songs or rhymes, or drawing and painting, - is learned through the medium of imitation. At 7 the child enters the school proper, and writing, reading and arithmetic are begun. Writing is taught before reading, since it involves a conative as well as a thinking element and thus helps to form a bridge from the first period to the second; and the children learn to read what they have already written. But the shape of the letters of the alphabet, as we have them today, is abstract and they have no longer any reference to the words which they represent. The alphabet, therefore, is introduced to the child pictorially. Thus, for example, in introducing the letter "W" the teacher may first speak to the children about the waves of the sea, which the class will then draw or paint, gradually arriving at the undulating shape of the letter through the picture, and which at the same time is the initial letter of the word. The other letters of the alphabet are similarly treated - "S" may be derived from "serpent", "M" from "mouth", and so on. Naturally, the teacher must be capable of entering into the child's phantasy and of exercising his imagination in his treatment of the different letters. In this way - a little story being told about each - a pictorial-affective link is made with the otherwise abstract form. Arithmetic is treated in a similar way. The child is not asked to think in terms of pure numbers before the age of 9. Up to that time all calculations are made in terms of something which can be mentally pictured - such as a barrel of apples to be divided, or little sums about the number of ducks or hens in a farmyard. A story is usually attached to the proceeding, and so the children learn to think within the framework of phantasy.

It is at the age of 8-9 that grammar is begun, and is treated likewise in a pictorial manner. At 10 a beginning is made of introducing the child to the kingdoms of nature, commencing with the animals, passing to plants in the following year, and finally to minerals at 12. But there is no question of formal zoology or botany at this period, the subjects being treated at this stage more artistically than scientifically.

History, as such, is first taught at age 11, preceded by some history of the neighbourhood at year 10, and accompanied by little biographies which, not given in book form, but graphically related by the teacher, play an important part in cultivating the moral feelings and an understanding for life. Fairy-tales, fables, and, later, the "Hero" stories of mythology form the material of such ethical training during the years 7 to 9.

Geography is also introduced at this age. To quote the "Lehrplan":

> "Geographie: Die Heimatkunde erweitert sich zur eigentlichen Geographie. Die Bodenkonfiguration und die wirtschaftlichen Verhältnisse näherer Teile der Erde werden besprochen. Wie die Geschichte, die von Taten und Leiden der Menschenseele handelt, den Menschen in sich selbst hineinführt, so soll die Geographie ihn möglichst weit aus sich hinaus zu den Räumen der Erde führen und in den Kindern das Gefühl des brüderlichen Verbundenseins mit allen Erdgebieten erwecken."

Something of the attitude toward school "subjects" can also be gleaned from the above quotation.

In regard to the mathematical subjects, the child is introduced to arithmetical fractions at 10, and to algebra at 12. At the latter age, also, geometrical drawing is begun, but no theoretical geometry is given until 14. An introduction to physics and chemistry is also given at 12, but in terms of concrete examples and experiment, theoretical considerations being only gradually developed out of these. It is at age 12 that some aspects of the teaching begin to deal with the abstract, such as in the case of algebra and in that of the physical and mechanical laws developed out of the experiments begun at this age. The child is led to these as far as possible through a development of the subject out of his earlier aesthetic training, so that music leads on to acoustics, and painting to optics.

It remains to mention that modern languages are taught by the "direct" method, two being given from the age of 7 upwards. The grammar of these languages is introduced at 11, and at this age also, Latin and Greek.

The different forms of artistic and manual work are also introduced at specific ages, among which are woodwork, wood-carving, clay-modelling, in addition to drawing and painting which are taught from the beginning; sewing, knitting, and darning - in which the boys take part, the girls, on the other hand, learning carpentry with the boys; while music, both vocal and instrumental, plays an important part throughout. In the Waldorf School there was not only a large choir, but both a senior and a junior orchestra, the former having some 50 performers. Choral recitation is also practised from the youngest class, as well as a new art called "Eurhythmy". (This is in no way connected with "Eurhythmics".)

No examinations are held at any time throughout the school course; but, on completion of this, pupils wishing to take university matriculation are given a year's coaching for this end. Neither the lack of practice in sitting examinations, nor the introduction of many of the school subjects at a later age than is usual, seems to have adversely affected the scholastic results. On the contrary, the number of passes of the German matriculation examination during the period 1924-34 by pupils of the school was 180 out of 214, or 85%.

Moreover, the educational aims of the school appear to have largely succeeded. By means of refraining from a too early intellectualistic training, and by keeping alive the imaginative and creative element in these children, the school succeeded in producing young people remarkable for their initiative and resource; while the ethical and social training which was interwoven with the ordinary work, resulted in the development of unusual qualities of reliability and social morality. When the National Socialist régime already began to threaten the existence of the school in 1933, a number of testimonials from business men and others who had employed ex-pupils of the school, was collected; and the present writer was fortunate in obtaining copies of some of these during his visit in 1934. Employers in the most varied occupations testified to the unusual qualities of these ex-pupils of the school, and the following examples are typical:

Owner of a <u>Soap Factory</u>, writing of 5 former Waldorf pupils, who had occupied posts on the clerical staff, as apprentices, and as journeymen:

> "Sie sind durchweg geistig beweglich and fleissig. Aufgefallen ist uns die allen eigene, stark soziale Einstellung and Hilfsbereitschaft gegenüber ihren Nebenmenschen. . . Wir würden gerne unsere sämtlichen Lehrstellen auch künftig mit Waldorfschülern besetzen."

An <u>Art Dealer</u>:

> "Ich kann auch feststellen, dass sie, durch mechanischen Drill nicht verbildet und durch Überfütterung mit Stoff nicht verlehrt, den Aufgaben des Lebens offener gegenüberstehen, als die Schüler anderer höherer Lehranstalten, bei welchen der Übergang von der Schulbank ins praktische Leben oft eine lange Anpassungszeit erfordert."

A <u>Cigar Manufacturer</u> writing of a young salesman:

"Von den Eigenschaften, die ihn vor meinen sonstigen Angestellten, besonders vor gleichaltrigen jungen Leuten, auszeichnet, nenne ich vor allem seine grosse Fähigkeit, die Bedürfnisse der Kunden zu erfassen und auf dieselben einzugehen. . . . In seiner Pflichterfüllung ist er unbedingt zuverlässig. Trotz seiner Jugend konnte ihm die Führung einer Filiale übertragen werden, die er uber ein Jahr zu meiner vollsten Zufriedenheit leitet."

The <u>Proprietress of an Estate</u> writing of a young girl - the first Waldorf pupil of whom she had had experience:

"E. hat eine sehr geweckte Beobachtungsgabe, sie beurteilt ihre Mitmenschen gerecht und versucht ihnen ein liebevolles Verständnis entgegen zu bringen. Es ist deutlich zu spüren, dass sie Lehrer gehabt hat, die sie individuell sich entwickeln liessen, ohne dabei egoistisch zu machen. Es ist ihr ganz klar, dass wir Menschen in Gemeinschaft leben müssen. Ihr Verhältnis zu Kameraden ist durch das lange gemeinsame Leben und Arbeiten mit ihnen in der Schule ein sehr erfreuliches. Ich kann dies nur erwähnen, weil es erlebt werden muss, wie Waldorfschüler und Schülerinnen kamaradschaftlich untereinander sein können."

A <u>Dentist</u> writing of a mechanic:

"Er hat sich in seiner Praktikantenzeit derart anständig und strebsam verhalten, dass ich ihn in seinem Verhalten und seinen Leistungen an die Spitze meiner Praktikanten stellen möchte, welche ich in 25 Berufsjahren ausgebildet habe."

Owner of <u>Import and Export Business</u>:

" . . . denn ich schätze das grosse Verständnis für die praktische Erledigung der verschiedensten Arbeiten sehr, welche der Schüler der Waldorfschule zeigt, und glaube bestimmt, dass diese nur auf die angewandte Lehrweise zurückzuführen ist."

The present writer also, during his three months' residence at the school was able to observe for himself what appeared to him as a much greater mental vitality among these children. He had also conversations with the school doctor, who pointed out that one of the visible results of this way of education - in addition to an entire absence of school nervousness - was the remarkably fewer cases of eye-sight defect in the school, as compared with other schools in Stuttgart. The writer was afterwards able to obtain confirmation of this statement from the records of the Medical Officer for Health in Stuttgart, details of which are given below. In the percentages for the Stuttgart schools the Waldorf School is of course included.

EYE-SIGHT DEFECT IN STUTTGART SCHOOLS.

		Grundschulen		Höhere Schulen	
		Boys %	Girls %	Boys %	Girls %
1928/29	Stuttgart Schools:	10.7	15.0	33.8	29.6
	Waldorf School:	9.5	8.0	18.0	16.0
1929/30	Stuttgart Schools:	13.2	16.4	35.1	28.9
	Waldorf School:	6.8	8.5	17.2	16.7
1930/31	Stuttgart Schools:	13.5	16.7	35.9	30.2
	Waldorf School:	6.8	3.8	18.5	20.5
1931/32	Stuttgart Schools:	13.2	16.6	35.6	29.6
	Waldorf School:	7.5	4.1	16.0	19.4
1932/33	Stuttgart Schools:	13.4	16.9	35.6	29.9
	Waldorf School:	7.4	11.6	16.6	20.4
1933/34	Stuttgart Schools:	13.6	16.0	35.2	30.3
	Waldorf School:	6.4	9.0	15.8	16.8

It would appear that eye-sight defect in children has some connection with nervous strain, produced by the type of education they receive.

Another physical result indicated by the school doctor was, that on his observation of these children, the period of the puberty change with them was shorter. This is understandable when one considers that, normally, mental work tends to retard physical growth and that children tend to grow more rapidly during school holidays than during the term. Thus a too intellectualised curriculum may well tend to inhibit, and so unduly prolong, the physiological changes at puberty; and the question arises as to what effect this may have upon the mental and physical health of the child at that time, or later. This, together with the whole question of the relation of school curriculum to physical growth, should form a fruitful subject for research.

In the Waldorf School it was not found necessary to divide the bright children from the dull, although the children were of all types and drawn from every social class; and the classes were arranged in accordance with chronological age without respect to intelligence. Large classes were used, these numbering 40 to 50 pupils being quite common; and although there were usually two parallel classes in each year-group, these were not arranged either according to sex or ability. One of the principles of the school, in fact, is that each class should be, as far as possible, a representative slice of the community, both socially and intellectually - this being part of the social training of the children - and only distinctly mentally defective children had to be excluded. These were not, however, excluded from the school, but were in charge of a special teacher in a "Hilfsclasse". No child was left behind in a class for the purpose of repeating any given year's work, but moved up with his or her own class year by year. It is part of these educational principles that the mental needs of a child depend fundamentally upon chronological age; and the fact that this school of over 1000 children was able to continue the practice of this principle throughout its entire existence, and with such conspicuously successful results, is almost in itself a refutation of any theory to the contrary.

It can thus be seen that not only is it possible to postpone the teaching of certain subjects without adversely affecting the scholastic results, but that this can yield, apparently, inestimable advantages to the pupils, both at the time and in adult life, and that it is possible to teach a class of children of widely varying intelligence without being obliged to retard the bright or to leave the dull behind. The whole point appears to be that, in the Waldorf School - as well as in the other schools in various countries which have since been started for the purpose of following these same educational principles - it is the aim of the teachers to adapt the subjects and the method of teaching to the actual needs of the child at each age, (i.e. in our terminology, to his 'mental structure'), the curriculum arising from that, and not, as is customary, from the needs of a state department. It must of course be added that, by a child's needs is here meant that which is demanded by his <u>quality</u> of mind as distinct from his degree of brightness; and it is at this point that those who do not recognise these qualitative differences in children will part company with us. In such a case one can only point to the results of the education in the Waldorf School where these differences were recognised, and invite them to compare these with the products of the ordinary schools where their own outlook largely holds sway.

The writer had the opportunity while in Stuttgart of questioning an ex-pupil of the Waldorf School as to what he remembered his feelings to have been while a pupil there. This young man had been through one of the German universities, and had now returned to the school to take the teachers' training course. He replied: "As each new subject was brought to me, I felt: "That is just what I want!"

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We may now consider some other subjects of a school curriculum in the light of our analysis in Table 2. Grammar, as we have seen, may be commenced at 8-9, provided that it is presented in terms of concrete ideas in relation. It should not be taught abstractly, nor should it be introduced so early as age 7, since relational thinking has hardly begun then.

Nature-knowledge which in any way involves a grouping of facts into wholes - such as flowers or animals into species, etc., should not be given until 10, when the child is able to grasp complex ideas in relation and simple factual rules. On the other hand, the giving of mere isolated facts of nature to a child of 7, for example, tends to force his attention toward concrete external details just at the time of the most rapid development of his conscious imagery. It is to the latter that we should appeal at this period. The age at which to encourage interest in the facts of the external world is after this imagery phase has died down, namely, at the zero point of 8 or 9. Prior to this stage, if we wish to act in accordance with the child's mental structure, we should allow him to live as much as possible in the element of phantasy. To interfere with this natural process in the child at that time is merely to help toward that killing of his imaginative life, to which reference has already been made. It will be noticed that in nearly all the graphs the "imagery" curve is predominant at this age.

The same consideration applies to stories told to a child of this age. To give him "history" - even in the form of stories connected with local buildings of historical interest - is to give him poor material for the exercise of his phantasy. A fairy-tale provides a far better stimulus and has at the same time in most cases an ethical value which the other has not. In the curriculum quoted at the beginning of this thesis, it was seen that children of 8 were to be given stories about Julius Caesar, the Goths and Huns, Agricola, and Egypt. There appear to be only two ways of treating history which can be of any real value to the child. The one is biographical and has ethical value; the other is developmental and has a value for understanding. But it is difficult to see what benefit a child of 8 can receive from little scraps of information which belong to neither category. History, as such, has no meaning unless seen as a continuous development, and this is admittedly beyond the powers of a child of 8. On the other hand, little stories about Julius Caesar, or the Huns, or the Egyptian pyramids, do not appear to have any ethical significance.

Before we do anything with a child educationally, we should pause to consider why we are doing it. We may think it rather nice - from our adult point of view - that a young child should know something about the flowers and the birds. But are we giving him this information at a time when he most needs it? We feel we ought to tell him stories about something, and since, as adults, we are interested in history, we tell him about Julius Caesar and the pyramids. But what does all this mean to the child and of what value is it to him? We are merely wasting time which should be devoted to the cultivation of his feelings as a basis for his future social behaviour, and for which purpose the ethical content of Fables and the stimulating example of Hero-stories meet his needs at 8-9.

History, when treated as a continuous development, should surely not be given to the child before he has the ability to grasp complex ideas in relation, and which is not normal before age 10. A child who cannot see the relationships involved in the more difficult forms of "Absurdity" test, is not yet ready to grasp historical relationships; and the relationships which are then introduced should not be abstract - such as was observed recently by the writer in the history book of a girl of 11, where "a commercial crisis in Belgium" was cited as one of the preliminaries to the Hundred Years War.

Geography, involving as it does a grasp of wholes of related ideas, should not be given before the same age. To be able at age 8 to mark towns and rivers on a blank map, and to know that linoleum is made in Kircaldy or linen in Dunfermline, is merely an exercise in factual memory. Like the tit-bits about Julius Caesar or Hannibal, it is merely so much "examinable" junk; and what the term "equator" can mean to a child of 7 - beyond a line drawn on the map - it is difficult to imagine. Fundamentally, geography is meaningless unless the parts of the earth studied can be grasped in their relationships; and with young children we are compelled either to fall back on the mere learning of unrelated facts, or to try to force them to grasp relationships for which their minds are not yet ripe . . . . A girl, age 9, whose homework the present writer superintended, read in her geography lesson that the west coast of this country is wetter than the east, with the explanation that the prevailing wind comes from the west, that it gathers moisture from the sea, and that it then meets the mountains which it "can't get through". And so, the book continued, the clouds must rise, upon which they meet the colder air which in turn causes rain.

The writer went over all this very carefully with the child, and on being asked to repeat it she replied that the wind brought moisture from the sea. What happens then? she was asked. "The clouds meet the mountains and can't get through them." And what happens then? "They explode!" she answered blandly. Then, when reminded of their rising, she added: "The cold air freezes the clouds, and it rains." At each step the child had to be prompted, there being no grasp of the process as a whole or of the causal relations. All that she could remember were the isolated facts.

Finally, there is the question of the primary subjects, reading, writing, and arithmetic. The first two do not - nor does arithmetic in its earlier stages - involve any form of relational thinking; but they all involve necessarily one thing, namely, the ability to control mental images. To read, and therefore also to write, involves the recognition of a series of letters as together forming a sound or series of sounds. Until a word is so familiar that it can be recognised automatically, the child must consciously combine the several sounds of the letters together. That is, the sound-image of the earlier letters must be "held" until the last one is reached, and then the individual letter-sounds are combined into the word-sound. Thus, control over imagery is an essential factor.

To teach children to read, therefore, prior to the age of 6-7 must involve a strain upon those - and that is the great majority - who cannot yet control their imagery. The Moray House experiment showed that, with the greatest possible assistance, 70% of the 5-year-olds failed to show adequate control; and it can safely be assumed that where so large a proportion fail, success is not easily achieved by the remainder.

An interesting case of this kind came under the writer's notice. A very bright little girl, age 5;7, was learning to read at school, and her mother reported to the writer that the child seemed to have acquired a dislike for school since she had left the Kindergarten class in which she had been very happy. Further, normally cheerful and easy to manage, the child had become very irritable, intractible and generally difficult. The writer knew the child well and can testify to her normal happy temperament.

At the mother's request, he superintended the child's reading "home-work" on two occasions, and he discovered that while the child knew the sounds of the individual letters, and pronounced them correctly, she could not put them together to form a word. She had to deal mostly with words of three letters, or, at least three sounds; but, having pronounced each sound separately in order, and managing, with assistance, to put the first two sounds together, she invariably by that time had "lost" the final sound, and usually invented another to take its place. It was plain that the child had not sufficient control over her imagery, and that the whole process of attempting to read was consequently a great strain to her. At the writer's suggestion, therefore, the parents had the child's reading and arithmetic stopped, and her temperament soon returned to normal.

Some months later, these subjects were resumed - this time without any visibly ill effect; and now, at the age of 7, this child can read very well, and enjoys it, having rapidly gone through some ten or more school "readers", and being in a class of children mostly a year her senior. One of the more recent of the books she has read is Hans Andersen's "The Snow Queen" (Chambers' Narrative Readers) and which is issued for children age 9 and 10.

That control of imagery is equally necessary for arithmetic, needs no emphasis. The simplest sum involves the holding of an image and the substituting of another image as each digit is added or subtracted, as the case may be.

It may be said, in short, that all scholastic work which involves more than mere parrot imitation, requires some elementary thought of a conscious kind, and this is not possible unless mental imagery can be isolated and controlled. This ability does not develop adequately until age 6-7, and therefore children should remain in the nursery class until that age. Six appears to be the usual age in the majority of other countries, and we in this country would appear to be almost alone in the practice of commencing formal scholastic work at age 5.

In an article "Physiological Age and School Entrance" by A.K. Beik, (44) the author points to a number of important physiological changes in the child of 6-7; and he mentions the following: Disturbances of growth in height and weight; Dentition; Change in rate of growth of both skull and brain; Growth of larynx and development of voice range; Control of eye-movements; Neuro-muscular control. (p.307). He concludes from these facts (p.313):

> " . . . the question arises as to whether the time of appearance of the first molars could not be cited as a point before which school duties should not be imposed."

More recently, under the title of "Education of children under seven years of age", (45) (a memorandum submitted to the consultative committee by the members of the education section of the British Psychological Society, under the chairmanship of Mrs. Susan Isaacs) the report states:

> "It seems to us of the first importance that the years from two to seven should be considered as a single educational unit. . . . . There is no evidence to justify the idea that any drastic change, either in rate of development or in kind, takes place to coincide with the changes in school life which external organisation now compels at about the ages of five and seven." (p.257)

It is interesting to note that the unitary nature of these early years is here recognised, but the corollary is not added that, for the same reason, scholastic teaching has no place during that time. There is a suggestion that reading, writing, and arithmetic should be less formally introduced - by means of play and games, and practical interests; but there is no definite suggestion that they are themselves unsuitable. Yet what does it mean, otherwise, to say that these years should be considered as a single educational unit? The change in mental activity which is involved as soon as these scholastic subjects are begun - however their introduction may be camouflaged - is a vital one psychologically; and if there is no change in development, either in rate or in kind, between the ages of 2 and 7, on what pretext are reading, writing, and arithmetic introduced at all? The authors do not appear to have thought their statement through, and to have considered its implications.

It is not intended in this final section to attempt anything so complex as a suggested school curriculum. All that has been attempted is to show - as indicated in the introductory paragraphs of this thesis -

how the results of our method of approach to the child, developed in the preceding sections, can be reflected back upon current educational practice. Much of this practice appears to be psychologically unwarrantable. There is a marked tendency to a premature intellectualisation of the child, forcing him to perform mental operations for which, structurally, his mind is ripe only some two to three years later, some subjects being presented altogether too early, and others in a too abstract way.

The rough indications of a revised curriculum given above are not merely theoretical. They happen to coincide very closely with that in use in the Waldorf School for a period of nearly 19 years, the concrete results of which have already been referred to. Judging by these results in contrast to the product of the ordinary type of school, it would appear that the effect of this present process of premature intellectualisation is - as those who follow the Waldorf School principles maintain - to kill the initiative and the creative elements in the young human being, to deaden the mind instead of to quicken it, and to make adult thinking inelastic and rigid.

Business men who employ these young people are aware of this, and frequently complain of it. Some three years ago the Chairman of the Edinburgh Chamber of Commerce said in a public address:

> "Indeed, it almost seems that if we are to maintain our position as a great industrial and commercial nation, we must see to it that a radical change is made in the training of our young people before they leave school - - - What we business people want to-day is the new blood of vision and initiative . . ."

The deadening effect of the system was also referred to more recently by a President of the Educational Institute of Scotland, in her presidential address. She criticised the present educational system -

> ". . . not because it is falling behind with regard to the ordinary school subjects, not because it fails as a preparation for earning a living, and not so much because it fails to develop brawn and muscle as fully as might be, but because it seems to me to be somehow failing to enable great masses of the people to keep their souls alive under modern conditions."

But there would appear to be consequences of a social kind also. If, as has been suggested - and the argument is a compelling one - premature intellectualisation can produce an emptily critical, and so destructive, attitude toward the environment, as well as a hunger for unhealthy excitement, it is a short step from this to some form of juvenile delinquency.

Various factors have been cited as causes of this present-day problem - unemployment, lack of parental control, the cinema, and so on; but while all these may no doubt be contributory, the pertinent question must be asked: Why should any of these factors lead <u>necessarily</u> to behaviour of an anti-social kind? That they do so is merely evidence of the fact that such tendencies are there in the child already.

The present writer feels convinced, from the psychological considerations put forward in this thesis, and from the insight into questions of moral training which he gained through the Waldorf School, that these external circumstances serve merely to fan into flame tendencies which are already smouldering underneath, and that the basic cause of these tendencies, and the responsibility for the social disease which arises from them, lie at the door of our system of education.

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